Improved Color Image Segmentation using Dynamic Region Merging

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Abstract— *In the field of image processing, Image quality is important. It can be improved using various operations like image segmentation, filtering, etc. Image segmentation is an improvement process in which features sharing similar characteristics are identified and grouped together. Most segmentation techniques are either region-based or edge based. Image is segmented depending on various features like grey level, intensity and colour. Colour image is divided into clusters using HSI (Hue-Saturation-Intensity) model. Consistency test is use to check similarity between regions. The consistency of predicate is decided by sequential probability ratio test. Merging of region follows the nearest neighbour graph and dynamic region merging algorithm. Depending on similarity, partitions are merged. This merging will give the enhanced segmented image which is the final output. Nearest neighbour graph is used to increase the speed and efficiency of above process. This improved image is useful in the field of medical and security purpose.*

Keywords — *DRM, SPRT, DP, Nearest Neighbour graph.*

I INTRODUCTION

Image segmentation is one of the famous method for image improvement. Segmentation helps to modify the image into [1] many regions which are basically larger representation of data. It is typically used in medical instruments where high accuracy and enlarge images are required. In short this is splitting and merging the images. This merging of the data follows different properties and different techniques [2].Image segmentation may use different techniques like region merging, matching, matting or any combination of these techniques. The output of the segmentation step is usually a set of clusters having similar features .The different properties may be pixels intensity values, texture of pixel. Image segmentation may need to separate objects and analyse each object individually to find the faults. Segmentation is typically deals with image identification problems. It can be considered the first phase of a pattern recognition process and particle identification. Application of image segmentation are mainly includes security purpose, object recognition, crime record investigation, computer application such as graphics, animations, medical imaging where enlarge images require for proper treatment. Here in this paper colour image is used as input, this image contains combination of various colours. The HSI model has Hue, saturation and intensity. Image gets converted into regions (clusters) of colours which are same in sheds, means segment the plane image into partition. But this is not perfect segmented image, so after HSI model next step is to check consistency of the regions using various features like intensity, grey level. These features are predicate or standards define to check the consistency. In the consistency test we are checking the similarity between the regions. To obtain the better segmented image nearest neighbour graph and dynamic region merging algorithm is used. In these algorithms, regions are sequentially merged which follows the principle of dynamic programming. This DRM algorithm gives automatic segmentation.

There are some different image segmentation methods like K-means (KM) [8] Clustering Methods, Histogram-Based Methods, Edge Detection Methods, Region Growing Methods , Model based, Level Set Methods, Graph Partitioning Methods, Watershed Transformation, Neural Networks Segmentation, and Multi-scale Segmentation. Relay Level set method [9], [10].

II LITERATURE REVIEW

Numerous research works in this field published in last few years has been studied giving following information. Image segmentation is partition of image into subparts which are divided according to certain criteria, image segmentation, is often a mandatory step in image analysis .A wide variety of segmentation methods has been proposed in the recent years.

Some of the methods discuss in detail as follows

A) Threshold based segmentation: This is simple technique as it is easy to use. Threshold divide the image mainly into two parts one with segment value as one, and second is with the segment value as zero. In short first set some dimension for the image regions, and then segment regions according to the dimension. It may use Histogram techniques to segment the image. This can be applied as a condition used before and after the image segmentation. [11]

B) Edge based segmentation: In this method first identify the edges of the image. Then process the

edges so that only boundaries of the regions will remain. Then convert this result into segmented image. After this identify the object with this technique with edge as criteria. It is generally used to identify these objects. [3]- [5]

C) Region based segmentation: This is different technique than edge detection technique. Here similarity between neighbouring regions is observed. If maximum similarity is present then make one group of these neighbours. Likewise proceed further up to stop criteria. In this type start with regions and we move towards outer part like boundaries. [12]- [15]

D) Clustering techniques: clustering is one of the famous 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 minimum Euclidian distance. Clustering is mainly divided into two types top down approach and bottom up approach [7] [8]

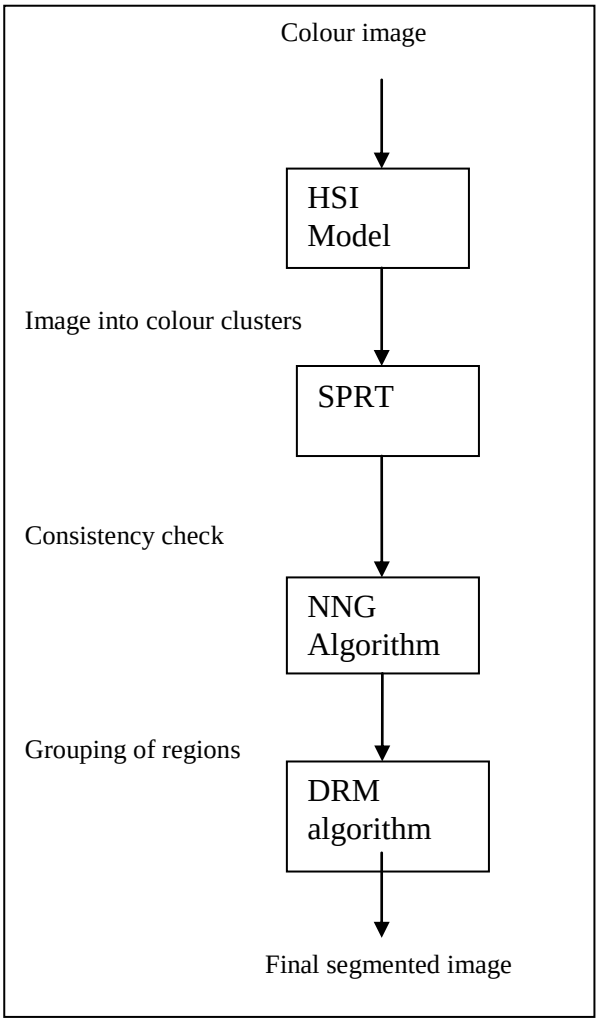
E) Matching: Once we are clear about what we have to search regions by that idea only, this is nothing but matching type of segmentation , In matching set the ideal object, and proceed for searching other object which having same feature as that of the ideal object. Locating the objects is possible with this type. This type of segmentation is known as matching. There are some modern methods for image segmentations like Artificial Neural Networks – SVM and FFNN, Neuro-fuzzy and soft-computing (SA) techniques, Active contours, watershed transform, Decision Trees and hierarchical analysis Probabilistic approaches. With this all above mention techniques good image segmentation is achieved, but perfect image segmentation is not achieved, because of the problem of over segmentation and under segmentation

III OVERVIEW OF SYSTEM

The system operation follows the steps mention below:

- HSI colour model is use at the initial stage .This model will segment the colour image into regions taking colour as feature. HSI form the colour cluster. It is hue, saturation, intensity model. In this paper intensity of colour is considered out of hue, saturation and intensity.
- Check similarity between these regions. The similarity can be in terms of intensity of pixels, colour of pixels or grey level of pixels thus we can check consistency of regions. Consistency of the region is calculated by sequential probability ratio test, which depend on the two fix assumptions. True assumption and false assumption. Then sort the data into two groups.
- Most consistent (similar) regions are merged first. This operation is proceeding sequentially up to stop condition. Operation follows principal of nearest neighbour graph it will allow better merging at the initial stage. Then use dynamic region merging which gives automatic image segmentation. Output of the DRM algorithm is enhanced segmented image. Dynamic region merging is heart of the system.

IV FLOW OF SYSTEM



A.HSI MODEL

This is the first input model that applying for color image segmentation purpose. It is basically color model. The name stands for hue, saturation, intensity model. The model performs color segmentation by taking hue, saturation, intensity as a feature for segmentation. With the help of this model improvement in the saturation and intensity of image is possible keeping hue of the image constant. Thus system will not disturb the hue. Many image processing application are based on this model such

as fusion of image, object detection, traffic light controller, medical applications. HSI model is more accurate than RGB model .In the below mention graphical representation both intensity as well as saturation are changing. Thus different saturation values at different intensity values can be obtain, here third parameter kept constant. Its graphical representation is as shown below.

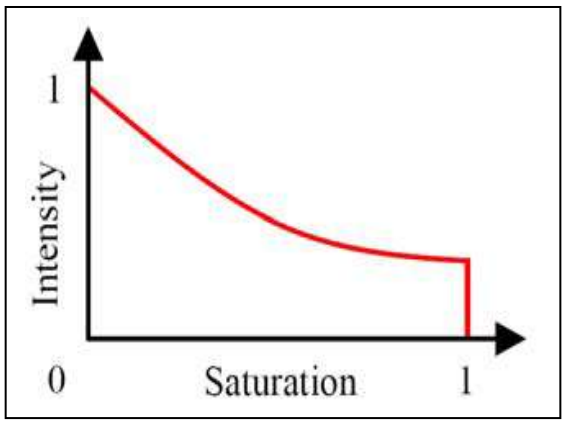


Fig 2.Saturation representation at different intensity values

B.CONSISTENCY TEST

This property checks the similar features in the image particles. 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 [18] to check if the regions are homogenous or not.

- Result=true, if neighbouring regions are same in desired features, then we merge the regions easily. It is also called as valid hypothesis.
- Result=false, if neighbouring regions are not same .or very contradictory features are present then hypothesis is known as alternative hypotheses.

In the implementation part of use SPRT test. 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 neighbouring 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.

C .NEAREST NEIGHBOR GRAPH

Once the consistency of the regions is check, start grouping the colour clusters. Reduce the distance between neighbouring clusters. This is very fast algorithm as compared to DRM algorithm, so it is used at the initial stage of the merging process. We can increase the speed and efficiency of the system using NNG [17].This will scan each region, as it is considered for small regions. Then apply DRM algorithm.

D.REGION MERGING ALGORITHM

There are different algorithms to merge the data. Though NNG is used at the previous stage, DRM is use to finally merge the data as it gives automatic and fine segmentation. A region description is compared with the description of adjacent region; if both are similar; merge them into a larger region. Otherwise regions are denoted as dissimilar regions. Such regions are not combining. Merging of adjacent regions will process for all combinations of neighbouring regions. If a region cannot be merged with any of its neighbours, it is marked `final' and the merging process stops when all image regions are so marked. This is the last process to merge the above mention regions. 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 discrete image and give each regions 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

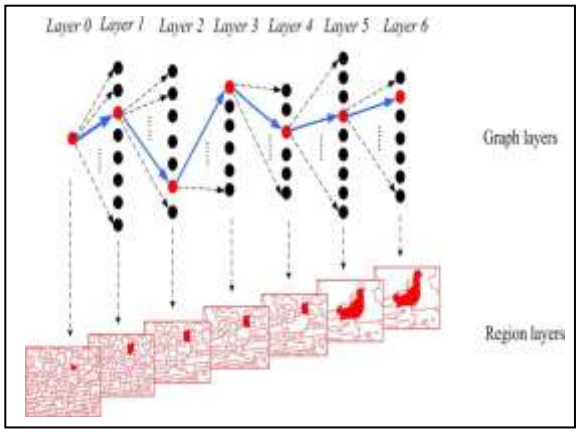


Fig 3.Dynamic region merging process

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 neighbour. If the region is merged with its neighbour, they will obtain to the same name of label. DRM algorithm is simpler than rest of the merging algorithms. Again it gives better efficiency than any other algorithm. Use large number of segmented data, because It gives more accurate results with more number of inputs. So it is better to use the DRM from efficiency point of view .K-means (cluster based) algorithm is alternative to the region merging. These output images are very useful as they give us detail and enlarge explanation of data; especially in military and medical applications.

Region merging generally follows order by which regions are merged. One of the simple methods is to begin merging by starting the segmentation using regions of 2x2, 4x4 or 8x8 pixels. Generally DRM require scanning whole graph. This is time consuming process, so use nearest neighbour graph method to increase the speed. DRM algorithm can tolerate some variations .The alternative to the DRM algorithm are mean shift algorithm [16] as well as graph based algorithm [14]

V PROPOSED SOFTWARE DESIGN

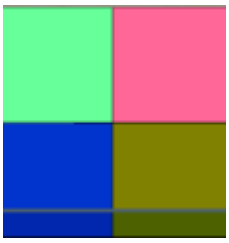
Interactive software is developed to do the reliable monitoring and management of segmentation process. The system software is made using MATLAB 12.We are implementing HSI model first on the plane colour image, and then applying consistency test using SPRT.Dynamic region merging algorithm and nearest neighbour graph then on colour 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, $\lambda 1$, $\lambda 2$.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 $\lambda 2=1$, then only $\lambda 1$ is the user input which can be vary.

VI RESULT

Following images are used to represent results

1) Input colour image

2) Region based segmentation



3) Output segmented image

VII CONCLUSION

Thus in this paper we studied the image improvement technique with the help of different algorithms such as HSI model, consistency test, dynamic region merging algorithm, nearest neighbour 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.

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REFERENCES

[1] D. A. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*. Englewood Cliffs, NJ: Prentice-Hall, 2002.

[2] L. Ladicky, C. Russell, P. Kohli, and P. Torr, "*Associative hierarchical CRFs for object class image segmentation*," in *Proc. ICCV*, 2009, pp.

[3] J. Canny, "A computational approach to edge detection," *IEEE Trans Pattern Anal. Mach. Intell.*, vol. PAMI-8, no. 6, pp. 679–698, Nov.1986739–746.

[4] R. C. Gonzalez and R. Elwood, *Digital Image Processing*. Reading, MA: Addison-Wesley, 1992.

[5] L. Zhang and B. Paul, "Edge detection by scale multiplication in wavelet domain," *Pattern Recognition. Lett.*, vol. 23, no. 14, pp.1771–1784, Dec. 2002.

[6] B. Paul, L. Zhang, and X.Wu, "Canny edge detection enhancement by scale multiplication," *IEEE. Trans. Pattern Anal. Mach. Intell.*, vol. 27, no. 9, pp. 1485–1490, Sept. 2005.

[7] Dorin Comaniciu, Peter Meer, "Mean Shift Analysis and Applications".

[8] S. Thilagamani1 and N. Shanthi, "A Survey on Image Segmentation Through Clustering", International Journal of Research and Reviews in Information Sciences Vol. 1, No.

[9] F. Lecumberry, A. Pardo, and G. Sapiro, "Simultaneous object classification and segmentation with high-order Wesley, 1992.multiple shape models", *IEEE Trans. Image Process.*, vol. 19, no. 3, pp. 625–635, Mar. 2010.

[10] R. C. Gonzalez and R. E. Woods, *Digital Image Processing*. Reading, MA: Addison

[11] National Programs on Technology Enhanced learning http://nptel.iitm.ac.in/courses/106105032/39,

[12] R. Nock and F. Nielsen, "Statistic region merging," *IEEE Trans. PatternAnal. Mach. Intell.*, vol. 26, no. 11, pp. 1452–1458, Nov. 2004.

[13] K. Haris, S. N. Estradiadis, N. Maglaveras, and A. K. Katsaggelos,"Hybrid image segmentation using watersheds and fast regionmerging," *IEEE Trans. Image Process.*, vol. 7, no. 12, pp. 1684–1699,Dec. 1998.

[14] P. F. Felzenszwalb and D. P. Huttenlocher, "Efficient graph-based image segmentation," *Int. J. Computed. Vis.*, vol. 59, no. 2, pp. 167–181,Sep. 2004.

[15] B. Peng, L. Zhang, and J. Yang, "Iterated graph cuts for image segmentation, "in *Proc. Asian Conf. computed. Vis.*, 2009, pp. 677–686

[16] D. Comanicu and P. Meer, "Mean shift: A robust approach toward feature space analysis," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 24, no. 5, pp. 603–619, May 2002.

[17] D. Eppstein, M. S. Paterson, and F. F. Yao, "On nearest-neighbourgraphs," *Discr. Comput. Geom.*, vol. 17, no. 3, pp. 263–282, Apr.1997.

[18] A. Wald, *Sequential Analysis*, 3rd ed. Hoboken, NJ: Wiley, 1947.