Parallel Image Segmentation using Multi- Processing

By Dynamic Developers

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Video Walkthrough

Problem Statement

In the domain of Image processing, Image segmentation has brought an extensive change. With image segmentation we can separate an image into several segments and make it much easier to analyze. Like many other processing techniques Image segmentation also faces some problems and most of the image segmentation techniques are not very efficient when the process becomes much more complicated.

Objective

Image segmentation is a technique for locating points and boundaries in images. Computer vision, medical imaging, anatomical structure analysis, object recognition such as pedestrian brake light, face detection, locate objects in satellite images (roads, trees, crops) and so on are just some of the applications. Most of the research in this area take a sequential approach, which means they take a long time to complete. As a result, we've proposed this approach, in which segmentation is performed in parallel.

Approach(es)

Dividing Images into N parts

- Used the python library Image_slicer
- Parsed the sliced image parts to image segmentation component

Image Segmentation

- Reshaping the image into a 2D array of pixels and 3 color values (RGB)
- Each tile is segmented using K-means algorithm
- Above step is repeated simultaneously with multiple processors.

Image Reconstruction

- After joining all the processors reconstruction of image is done by concatenation and image is retrieved

Result

Original Image | Final image

Discussion

As we have seen in the results the time difference between running the algorithm sequentially and parallel is clearly visible. The lesser time complexity establishes our method's robustness as well as, agility. But running the algorithm in parallel comes with its own cons like the line of division of image is clearly visible.

References

[1] R. H. Turi and S Ray "K-means Clustering for Colour Image Segmentation with Automatic Detection of K", Proceedings of the International Association of Science and Technology for Development (IASTED), Signal and Image Processing (SIP '98), Las Vegas, Nevada, USA, 28-31 October ,1998, IASTED/ACTA Press, CA, USA, ISBN: 0-88986-274-5 & ISSN: 1482-7921, 345-349.

[2]. S. Ray and R H. Turi "Determination of Number of Clusters in K-means Clustering and Application in Colour Image Segmentation", Proceedings of the 4th International Conference on Advances in Pattern Recognition and Digital Techniques (ICAPRDT'99), Calcutta, India, 27-29 December, 1999, Narosa Publishing House, New Delhi, India, ISBN: 81-7319- 347-9, pp 137-143.

[3]. T. Kanungo, N. S. Netanyahu and A. Y. Wu "An Efficient k-Means Clustering Algorithm" IEEE Transactions on pattern analysis and machine intelligence, vol. 24, no. 7, July 2002.

[4]. M. Luo, Y-F Ma and H-J Zhang "A Spatial Constrained K-means Approach to Image Segmentation" Information, Communications and Signal Processing, 2003 and Fourth Pacific Rim Conference on Multimedia.

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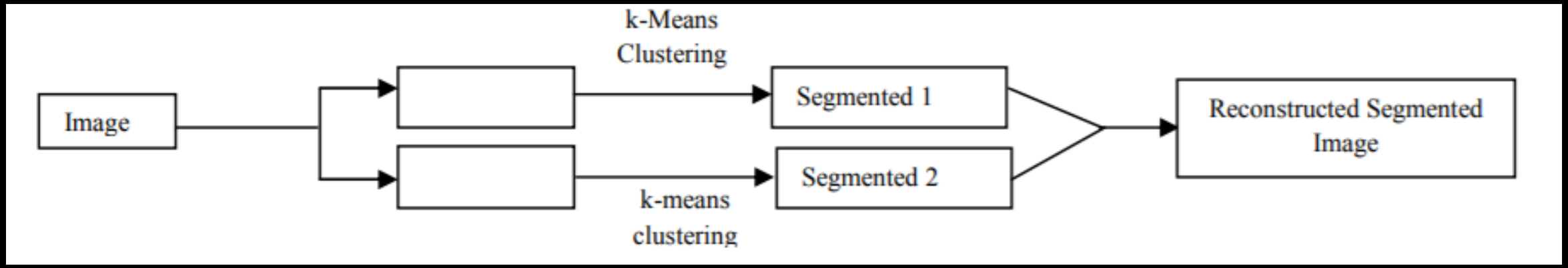

Explanation of the image segmentation using Multiprocessor for 2 parts.

Approach

PROPOSED METHOD

Step 1.	**Color image is divided into 2, 4 or 6 parts and each part is processed by different processor.**
Step 2.	**Each tiles height, width and segmentation number is set.**
Step 3.	**Each tile is segmented using modified K-means algorithm.**
Step 4.	**For every part, according to minimal cluster, each instance to the cluster with the nearest centroid is assigned.**
Step 5.	**Every instance is taken in sequence and distance from the centroid of each cluster is calculated.**
Step 6.	**If current centroid is not closest.**
Step 7.	**The instance is removed from the centroid.**
Step 8.	**Add to that cluster having the closest distance.**
Step 9.	**The centroid is updated.**
Step 10.	**Step 5-9 for 2, 4 or 6 processors is repeated simultaneously.**

K means clustering algorithm

K-means algorithm is one of the most known clustering algorithms. It is an unsupervised machine learning algorithm The algorithm implements a square error criterion. It starts with defining number of initial centroids(k). Then the data points are reassigned to a nearest cluster. Now through iterative calculations new centroids are assigned to optimize the position of centroids. This process continues until a convergence criteria is met.

Result

Original Image

Final image

Result

2 Segments

4 Segments


6 Segments

Result

After splitting the image in 2,4 and 6 parts we have obtained the following results

Processors Used	# of splits	Time Taken
1 (Sequential)	N/A	00:02:12
2	2	00:01:53
4	4	00:01:44
6	6	00:01:37

From the table it can be inferred that the time taken by the sequential programming was slightly more than the time taken by multi-processing programming.

Result

After splitting the image in 2,4 and 6 parts we have obtained the following results for batch

Processors Used	# of Splits	Time Taken (Batch of 15 Images)
1 (Sequential)	N/A	36:01:01
2	2	31:59:09
4	4	25:23:03
6	6	22:45:57

This table shows time taken when we run our algorithm for not just one image but for a batch (batch size 15) .

Discussion

As we have seen in the results the time difference between running the algorithm sequentially and parallel is clearly visible. The lesser time complexity establishes our method’s robustness as well as, agility. But running the algorithm in parallel comes with its own cons like the line of division of image is clearly visible.

Conclusion and Future Scope

Using both k-means clustering and multi-processing programming, our proposed algorithm successfully segmented the picture. These methods and knowledge can also be used in multi-threaded programs for segmentation. Other segmentation techniques can be used for this type of method and can be compared with the results of our process, which can be an area for further research.

References

[1].R. H. Turi and S Ray “K-means Clustering for Colour Image Segmentation with Automatic Detection of K”, Proceedings of the International Association of Science and Technology for Development (IASTED), Signal and Image Processing (SIP '98), Las Vegas, Nevada, USA, 28-31 October ,1998, IASTED/ACTA Press, CA, USA, ISBN: 0-88986-274-5 & ISSN: 1482-7921, 345-349.

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Thankyou Buddy