Segmentationusinggraph - Cut for Red, Green, Blue Planar Images

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Abstract— The work addresses concept of Segmentation in three planes of images. Technique which performs Segmentation of an image based on Graph-Cut approach is discussed. An image is considered as a group of nodes in a Graph G(V,E) where V are Nodes & E are Edges whereas Energy Minimization technique were employed in order to have a minimal Cut. The technique graph-cut provides a globally optimal solution; however the complex image makes it hard to segment the whole image all at once. The minimum cuts in a graph with two terminals can be computed in low order polynomial time and based on well known optimization. Subjective Analysis has been done to discuss the quality of Segmentation.

Key words: Energy function, Min-cut/max-flow, Segmentation, Optimization

I. INTRODUCTION

Segmentation is an important part of image analysis. It refers to the process of partitioning an image into multiple segments. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.[1,2,5,7] Segmentation change the representation of an image into something that is more meaningful and easy to analyse. The process of image Segmentation consists of transforming an image into different phases, while keeping track of important properties of each phase. This can be used for analysis of the image for further processing of the image, as each of the different phases of the image can be treated differently after a segmentation process.

The one of the main application of segmentation is Object Detection[3,6]. Interactive segmentation is becoming more and more popular to remove the problems inherent to fully automatic segmentation. The main goal is a general purpose interactive segmentation that divides an image into two segments: "object" and "background".[6] A user indicating certain pixels to be a part of an object of image and other to be a part of the background for imposing certain hard constraints of segmentation. These hard constraints give the idea of what the user intended to segment. Threshold techniques, edge-based methods, region-based techniques and connectivity preserving relaxation methods are the four main techniques for segmenting an image.[7,8]

A. An overview of Techniques for Segmentation

1) Thresholding

The earliest method of image segmentation is called the THRESHOLDING method. This method is based on converting agray-scaleimage into a binary image. There isalso a balanced histogram thresholding.Shown in figure 1.1.

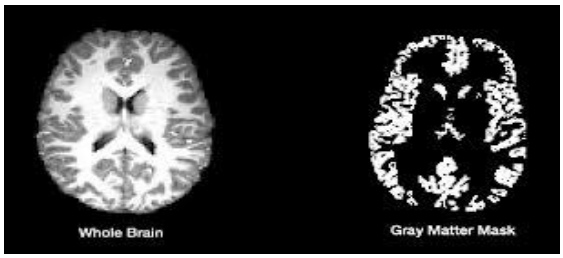

Fig. 1.1: Thresholding Segmentation

The key of this method is to select a global threshold value.

2) Clustering Based Segmentation

It divide theimage into K-different clusters. the K-means algorithm is an iterative method/technique that is used to partition image into K-clusters. See figure 1.2.

The basic algorithm is:

(1) Pick K cluster centres, either randomly or based on some heuristic.
(2) Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster centre.
(3) Re-compute the cluster centres by averaging all of the pixels in the cluster.Repeat step 2 and 3 until convergence is attained

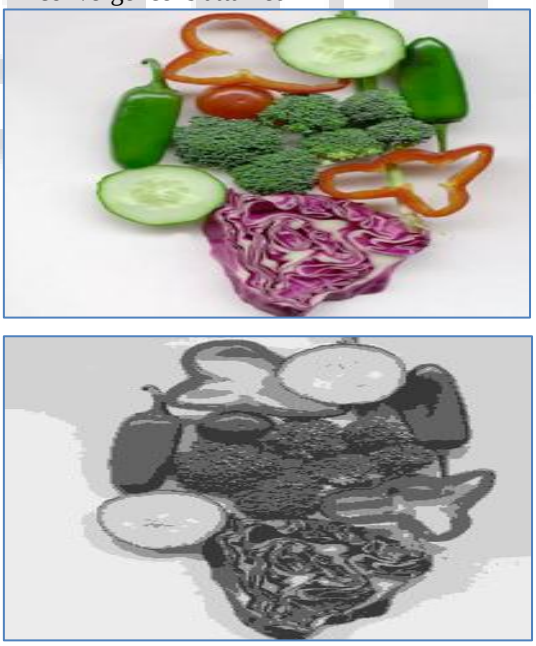

Fig. 1.2: Clustering of Image

3) Compression Based Method

This method postulates that the optimal segmentation is the one that minimizes, over all possible segmentations, the coding length of the data. The connection between these two concepts is that segmentation tries to find patterns in an image and any regularity in the image can be used to compress it. The method describes each segment by its texture and boundary shape. Each these components are

modelled by a probability distribution function and its coding.

4) Histogram Based Method

This method is very efficient when compared to other image segmentation methods because they typically require only one pass through the pixels.

In this technique, a histogram is computed from all of the pixels in the image, and peaks and valleys in the histogram are used to locate the cluster in the image. Colour, intensity can be used as the measure as in Figure 1.3.

The graph is then partitioned according to a criterion designed to model "good" clusters. Each partition of the nodes output from these algorithms are considered an object segment in the image.

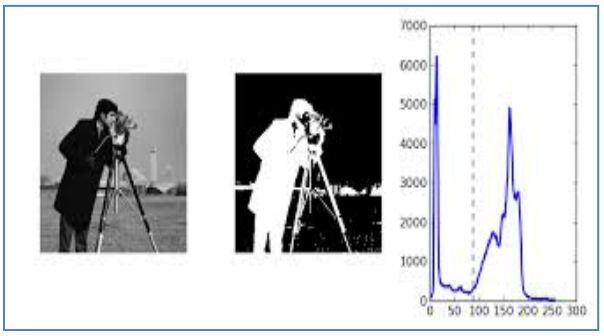

Fig. 1.3: Segmentation of an Image and its Histogram

II. Segmentation With Graph-Cut

Graph consists of nodes and vertices. A directed or undirected graph or simply a graph G(V,E) consists of set of nodes V and set of edges E that connects them. The nodes represent the pixels of the image. A graph contains two special nodes called terminal nodes show in figure 2.1. With that the image is divided into two regions, one "object" and other "background" region.[1,7,10,12] The terminal nodes are source or object, s and sink or background, t. Below is the figure of graph show both the terminals.

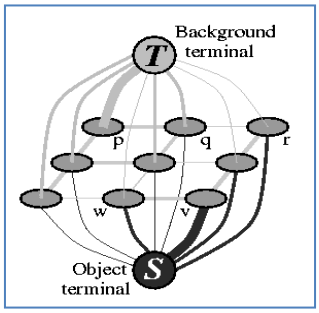

Fig. 2.1

In the graph all the edges have some weights or cost assign to them. The cost of the directed edge(p, q) is different from the cost of the reverse edge(p, q) .

C(S, T) = ∑ C(u, v)

u ∈ S, v ∈ T, (u,v) ∈ E

For many graph based applications in computer vision it is important to assign different edge weights for (p, q) and (q, p)[1,4,12]. Image segmentation methods can be divided into variational and combinatorial methods ([6,8]).

These two methods can also be further based on how the boundary is represented. Combinatorial methods like "path-based" graph methods that use explicit boundary representation[9,11] On the other hand, variational method such as Interactive Graph Cuts ([6,8,9]) uses implicit boundary representation.

A. Segmentation Energy

Consider an arbitrary set of data elements (pixels) *P* and some neighbourhood system represented by a set *N* of all (unordered) pairs {p, q}of neigh boring elements in *P*. I have to use this Boundary Function for segmenting an image.

Where

$$R(A)=\sum_{p\in P} R_p(A_p)$$

is the Regional Term

$$B(A)=\sum_{\{p,q\}\in N} B_{\{p,q\}}\cdot\delta(A_p,A_q)$$

is the Boundary Term

$$\delta(A_p,A_q)=\begin{cases}1 & if \quad A_p\neq A_q\\ 0 & otherwise\end{cases}$$

$$B_{\{p,q\}}\propto \exp\left(-\frac{(I_p-I_q)^2}{2\sigma^2}\right)\cdot\frac{1}{dist(p,q)}$$

Segmentation method based on Energy can distinguished by the type of the energy function used and the technique used for minimizing it.[1,4].

Algorithm can be divided into two large groups:

(1) Optimization function is defined on contour or surface.
(2) Cost function is defined on discrete set of variables.

III. Proposed Method For Segmentation With Graph-Cut For Red, Green, Blue Planes

Here the image is segmented using R,G,B colour planes.
Quality of Segmentation is measured on WEIGHTAGE SCALE AS (1 to 5)

(1) Very Good
(2) Usable
(3) Average
(4) Not Usable
(5) Poor

Here, The Explanation of the WEIGHTAGE SCALE is:

(1) Very Good means:
  (1)Details in Small Region
  (2)Details in Large Region
  (3)Shape of Overall Object
  (4)Usable means: 2 out of 3
(2) Average means: 1 out of 3(1.2)
(3) Not Usable means: 1 out of 3 (not 1.1 and 1.2)
(4) Poor means: None of these.

A. Mri Coloured Image

1) Gray Plane of Image: Output

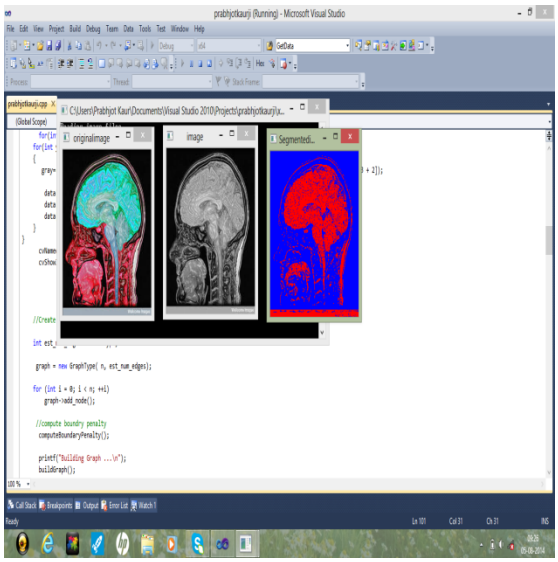

Fig. 3.1

Subjects	Mri Image Weightage (W)
(A)	**1**
(B)	**1**
(C)	**1**
(D)	**1**
(E)	**1**

B. Blue Plane of Image: Output

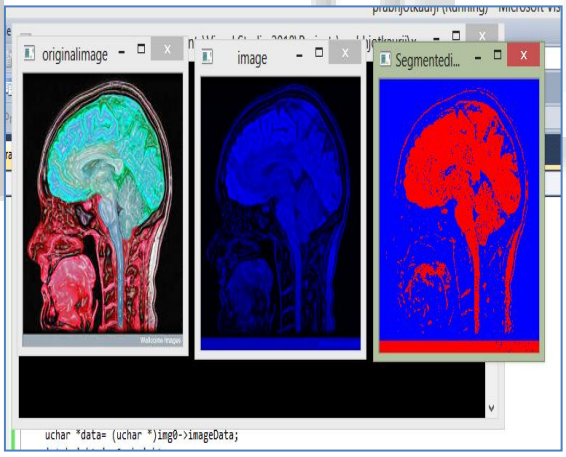

Fig. 3.2

Subjects	Mri Image Weightage (W)
(A)	**4**
(B)	**2**
(C)	**2**
(D)	**3**
(E)	**3**

C. Green Plane of Image: Output

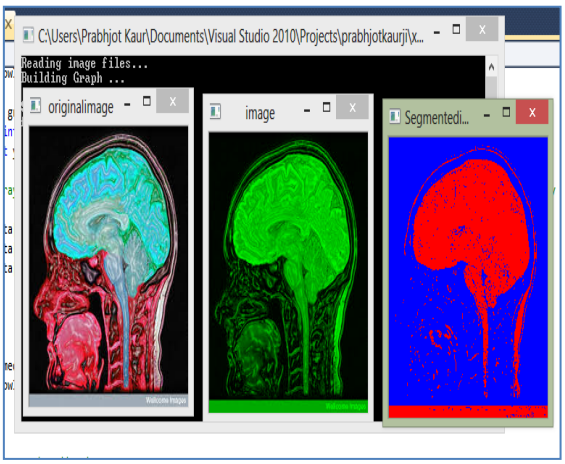

Fig. 3.3

Subjects	Mri Image Weightage (W)
(A)	**3**
(B)	**3**
(C)	**3**
(D)	**3**
(E)	**3**

D. Red Plane f Image: Output

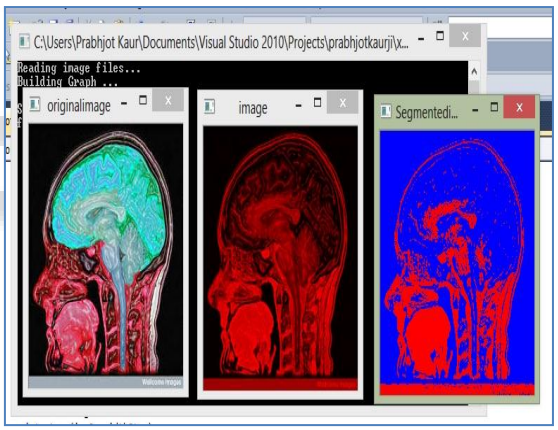

Fig. 3.4

Subjects	Mmriimage Weightage (W)
(A)	**3**
()((B)	**4**
(C)	**4**
(D)	**1**
(E)	**1**

IV. CONCLUSION

Study of Segmentationof an image for Red, Green, BluePlanes is done Subjectively. Here the result of MRI image is shown in which the MRI coloured planar image give a "very good" result, means that, the smaller region, the larger region and the overall object shape is extractedclearly. The result for MRI Blue planar is "usable"means any two results are shown out of these three i.e either small region, large region or overall object shape is shown.

Same technique is used for Synthethic image, Infrared image and Infrared Astronomical image.

REFRENCES

[1] Yuri Bokyov**"**Graph Cuts and Efficient N-D Image Segmentation".Computer Science, University of Western Ontario, London, ON, Canada andGARETH FUNKA-LEA,USA(2004*)*

[2] BoPeng, Lei Zhang, and Jian Yang"Iterated Graph Cuts for Image Segmentation" Department of Computing, The Hong Kong Polytechnic University, Kowloon, Hong Kong, China. School of Computer Science and Technology, Nanjing University of Science and Technology, Nanjing 210094, China.

[3] Yuri Boykov and Vladimir Kolmogorov"An Experimental Comparison of Min-Cut/Max-Flow Algorithms for Energy Minimization in Vision" In IEEE Transactions on PAMI, Vol. 26, No. 9, pp. 1124-1137, Sept. 2004.

[4] Boykov,Y., Jolly,M. P "Interactive graph cuts for optimal boundary and region segmentation of objects in N-D Images" International Conference on Computer Vision, vol. I, pp 105-112(2001).

[5] Michael McGrath "Markov Random FieldImage Modelling" Degree Of Master Of Science at the University of Cape Town, South Africa, June 2003.

[6] Yuri Boykov, Olga Veksler, RaminZabih "Markov Random Fields with Efficient Approximations" Proceedings of IEEE conference on" Computer Science Department Cornell University Computer Vision and Pattern Recognition" (CVPR), 1998.

[7] Anders P. Eriksson, Olof Barr and KalleAstr□om "Image Segmentation using minimal graph-cut" Centre for Mathematical Sciences, Lund University, SWEDEN.

[8] A. Goldberg and R. Tarjan "A new approach to the maximum flow problem" Journal of the Association for Computing Machinery, 35(4):921–940, October 1988.

[9] Yuri Boykov, Olga Veksler, and RaminZabih "Fast approximate energy minimization via graph cuts" IEEE Transactions on Pattern Analysis and MachineIntelligence, 23(11):1222–1239, November 2001.

[10] Vladimir Kolmogorov and RaminZabih "Visual correspondence with occlusions using graph cuts" In International Conference on Computer Vision, pages 508–515, 2001.

[11] PushmeetKohli Philip H.S. Torr "Efficiently Solving Dynamic Markov Random Fields using Graph Cuts" under the PASCAL Network of Excellence, IST-2002-506778 UK patent application number P106738GB, filed May 2005.

[12] Sara Vicente, Vladimir Kolmogorov and Carsten Rother "Graph cut based image segmentation with connectivity priors".

