International Journal of Mathematical Archive-7(5), 2016, 1-4
Available online through www.ijma.info ISSN 2229 – 5046

AUTOMATION SEED SELECTION BASED GRAPH CUTS METHOD FOR IMAGE SEGMENTATION

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(Received On: 13-04-16; Revised & Accepted On: 06-05-16)

ABSTRACT

The main objective of this research is the applications of graph theory in image processing, in particular image segmentation. Even though lot of methods are available at present, the graph theoretical method is a highly efficient and simple way to perform image segmentation. Segmentation performs the subdivision of the image into subsequent regions or objects. Medical imaging is one of the most attractive, challenging and emerging research topics in image processing. Modern research methods in image segmentation have highlighted the prospective of graph based techniques for medical applications. The focus of this paper is to develop a novel method which involves automatic seed selection for labelling in graph cut method for image segmentation.

Keywords: *Image segmentation, graph-cut, seed selection and labelling.*

1. INTRODUCTION

Discrete Mathematics is the branch of Mathematics which deals with the study of discrete objects like integers, peoples, houses, birds, etc. Digital computers are based on discrete "atoms" (bits) i.e., information is stored and manipulated by computers in a discrete fashion. 0101101…. . Therefore, both a computer's structure (circuits) and operations (execution of algorithms) can be described by discrete Mathematics [1]. Concepts from discrete mathematics are useful for describing objects and problems algorithmically and analyze the time and space complexity of computer algorithms and programming languages. Image segmentation involving pre-processing step do partition of an image into different regions which plays an important role in computer vision, objects recognition, tracking and image analysis. There are large numbers of methods available in image segmentation that extracts the required foreground from the background. The method depends on the region of interest. However, most of these methods are solely based on boundary or regional information which has limited the segmentation result to a large extent. Since the graph cut based segmentation method was proposed, it has obtained a lot of attention because this method utilizes both boundary and regional information. [2]

2. PRIOR ART

Image segmentation is a vast area. So some of the important review of the previous work is discussed related to the graph cut algorithm is quoted here.

The intelligent scissors algorithm treats the image as a graph where each pixel is associated with a node and a connectivity structure is imposed. This technique requires the user which is a manual method and place points along the boundary of the desired object. The object boundary is decided by the Dijkstra's algorithm, which is used to compute the shortest path between the user-defined points and this path is treated as the object boundary. The algorithm is simple to implement, very fast and may be used to obtain an arbitrary boundary with enough points. Even though the method is simpler, unfortunately, a low-contrast or noisy boundary may require the specification of many points and the algorithm is inapplicable to 3D boundaries [3].

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The graph cuts technique has been developed as a method for interactive, seeded, segmentation. As with intelligent scissors, graph cuts views the image as a graph, weighted to reflect intensity changes. A user marks some nodes as foreground and others as background and the algorithm performs a max-flow/min-cut analysis to find the minimum-weight cut between the source and the sink. A feature of this algorithm is that an arbitrary segmentation may be obtained with enough user interaction and it generalizes easily to 3D and beyond. However, although performing well in many situations, there are a few concerns associated with this technique. [3]

The second direction of extension to the graph cuts algorithm followed from the iterative estimation of a color model with the graph cuts algorithm. This iterative color model was later coupled with an alteration of the user interface to create the Graph Cuts algorithm. The Graph Cuts approach asks the user to draw a box around the object to be segmented and employs the color model as priors ("t-links") to obviate the need for explicit specification of foreground seeds. The added color model is of clear value in the application of color image segmentation and the "box-interface" requires less user interaction. Although the approach does perform well in the domain of color image segmentation, the iterative nature of the algorithm does increase the computational burden of the algorithm (requiring a solution to the max-flow/min-cut problem on each iteration) and there is no longer a guarantee of optimality (the algorithm is terminated when the iterations stagnate).[3]

The authors Zahn, Wu and Leahy are the first in applying the concept of graph theory to problems in image analysis. Most subsequent algorithms have focused on the spectral properties of the graph, although the isoperimetric algorithm and the Swendsen-Wang algorithm are notable exceptions.

Based on the various literature reviews, it is decided to implement a automatic seed selection method based graph cut method.

3. DEVELOPED METHODOLOGY

Automatic seed selection based Graph cuts are segmentation techniques that divide the image into two parts, called "object" and "background". The proposed methodology is shown in the block diagram.

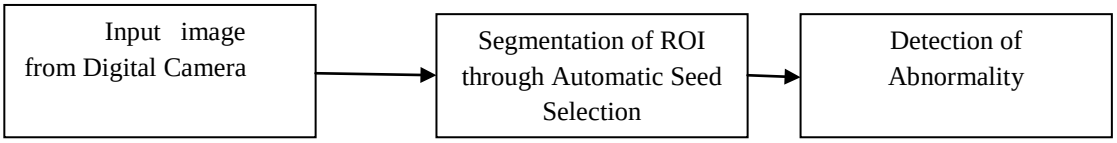

Fig. – 1: Proposed Methodology

A seed point is the important point for selection in segmentation. If a seed point is selected outside the region of interests (ROIs), the final segmentation result would be definitely incorrect. The following steps describe the automatic seed selection method.

1. For the given image histogram minimal values are calculated.
2. Base on the local minima value it is decided to take the threshold and labelled as cut1.
3. This makes the difference between white and black background. If the ratio of the number of foreground points and the number of background point is less than 0.1, let t equal to the next local minimum.
4. Continue until ratio is no less than 0.1.
5. Find all the connected components in the region not in cut1.
6. Delete the boundary-connected regions
7. Determine the seed point:

For most cases, the centre of the winning region ((x min+ x max)/2, (y min +y max)/2) could be considered as a seed point. However, there are cases that the lesion shape is irregular and thus the centre point might be outside the lesion. For these special cases, we choose a seed point by the following rule:

First point as an intersection point and the second point with in label cut1.

4. EXPERIMENTAL RESULTS

A sample image and the results shown by manual selection of labels is taken and compared with the automatic seed selection based segmentation method. Figure 2 is a sample image taken for analysis.

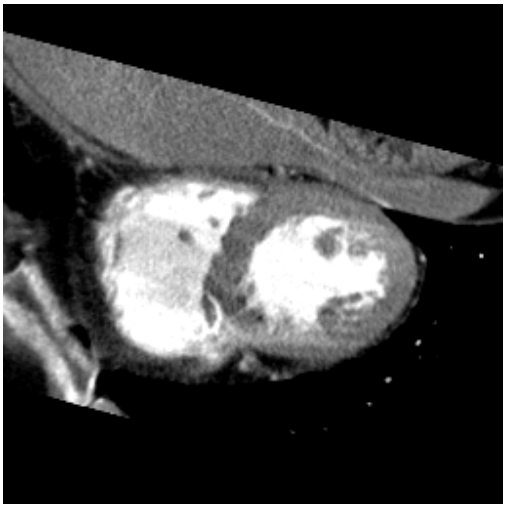

Fig. - 2: Input Image

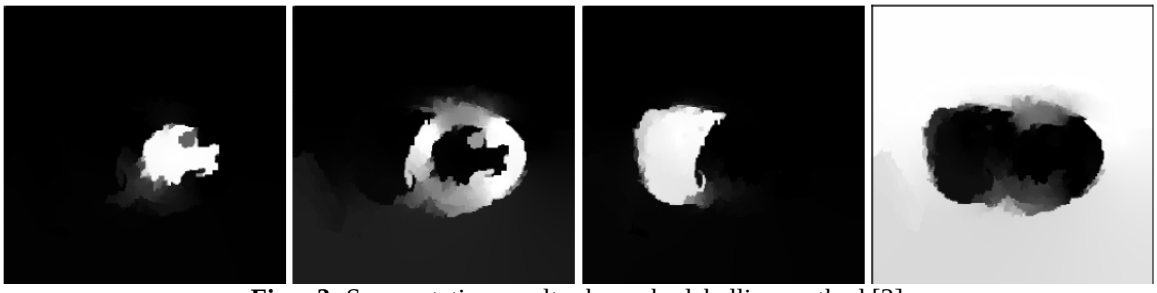

Fig. - 3: Segmentation results shown by labelling method [3]

Figure 3 shows the segmentation results by labelling method described in [3]. It involves labelling manually and then segmenting the images.

The same sample image is taken and the proposed methodology is implemented. The results in various steps are shown. As an initial step, the histogram of the image is shown in the figure4.

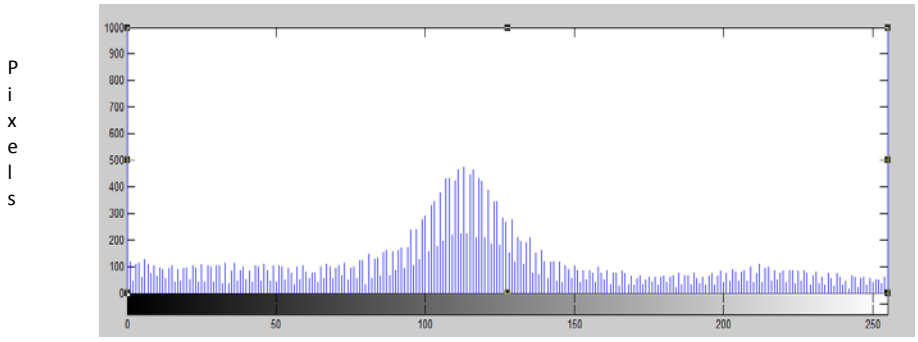

Fig. - 4: Histogram of the Input Image

From the histogram analysis, the white and black background is identified based on the threshold value. Then the connected components are labelled. Based on the values automatically seed is selected for segmentation.

Fig. – 5: Segmentation results after automatic seed selection

5. CONCLUSION AND DISCUSSIONS

In this paper we proposed a completely automatic segmentation algorithm based graph cuts technique. Seed point selection is based on textural and spatial information. Experiment results show that our proposed method provides a considerable estimation of the abnormality in the images. Also the processing time for the proposed method is calculated. Even though lot of calculations are there, the method takes very less time in ns. For the sample image shown it took 27ns as the computation time.

6. REFERENCES

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Source of support: Nil, Conflict of interest: None Declared