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A Relative Comparison of Graph Based Techniques for Image Segmentation

Basavaprasad B [1], Ravi M [2], Arshi Jamal[3], Ishrat Begum [4], Syed Minhaj Ul Hassan[5]

[1, 2, 3, 4, 5] Department of Computer Science, Government First Grade College, Raichur

Abstract

Image division is one of the significant steps of image processing used in investigate the image. Image may be generic or medical. Even though a lot of research has been done on this topic, there is no ideal result for the task of image segmentation has been found and it till now it is a tough task since the features of the image are lot. There are numerous image segmentation techniques available. But among all graph based methods have been practically proven to be most effective and are having wider scope for further work. It is simply because graph based methods unambiguously classify the image components into a very good mathematical structures which intern builds the computation of the task further supple and the calculation even more proficient. An organized investigation of graph-based method for image division is presented in this paper. Firstly, the problem is represented by means of dividing a graph into a number of sub-graphs so that each divided segment corresponds to a significant object of interest in an image. These methods are broadly characterized into three types based on the approach: graph based methods with cost functions, graph based methods based on Markov Random Field (MRF), and the minimal path based techniques. A detailed technical explanation for each category is given. We used five quantitative evaluation indices namely, PR (Probabilistic Rand) index, NPR (Normalized Probabilistic-Rand) index, GCE (Global Consistency-Error), BDE (Boundary-Displacement Error) and VI (difference of Information) which played a vital role in graph based image segmentation.

Keywords: segmentation, graph academic methods, GCE, PR index, BDE, VI.

INTRODUCTION

Picture division is a customary and significant errand in PC representation. It tends to be characterized as the way toward isolating and sub-partitioning a picture into various separate

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segments called as sections so that each portion speaks to a huge piece of the picture. A great deal of overview on picture division has been done in the course of recent many years. Among them a portion of the methodologies have accomplished an astonishing accomplishment and got gainful in some mainstream applications, not many of them are, clinical picture preparing [1, 3, 18], acknowledgment, picture reclamation, object following.

Among the a lot of picture division draws near, many are effective by methods for planning the picture segments onto a structure of diagram. After that the picture division task is comprehended in a generous methods by utilizing operational devices of hypothesis of diagram. The main favorable position of speaking to the division into a chart [16] is that it needn't bother with discretization by methods for righteously combinatorial administrators and there for gain no mistakes in discretization. Despite the fact that a lot of work has been done on picture division, we have less audit works in this ground. A deliberate report and review of numerous huge chart hypothetical strategies for picture division is introduced in this paper, where the division cycle is generally demonstrated by isolating a diagram (picture) into a few sub-charts (sections). In diagram hypothesis phrasing this partitioned chart is called bi-partite chart.

This paper gives a precise survey of diagram hypothetical techniques which we extensively partition them into three classifications. (I) Graph based technique with cost capacities; Here, the various capacities for apportioning the diagram will be utilized which are practical. Just by streamlining these capacities, we can accomplish compelling and valuable picture division. (ii) Graph put together strategies with respect to Markov arbitrary field (MRF) models [17];here the point is to consolidate the intelligent measurements with the delicateness in the diagram cut capacity. Utilizing this MRF model system, the enhancement is accomplished by utilizing the customary min-cut/max-stream methods. (iii) The briefest way chart based strategy; here, for the district of revenue, a limit is characterized on a bunch of most brief ways among the vertices sets of a diagram. Client cooperations are required here to screen the division cycle. Henceforth, the cycle is further graceful and can manage the cost of helpful results.

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LITERATURE SURVEY

The terminologies of graph theory that are used in graph based segmentation techniques are explained in this section.

Let $G = (V, E)$ be a graph in which $V = \{v_1, v_2 \ldots, v_n\}$ is a set, containing all the vertices which represents the pixels of image, in the Euclidean space. E is a set which contains edges connecting the pair of adjacent vertices. Every edge denoted by $(v_i, v_j) \in E$ has a matching weight $w(v_i, v_j)$ that computes a definite quantity depending on the properties among the two vertices which are connected by that edge. The segmentation criteria [4] which is accepted, says that all the pixels of an image in each component must contain uniform and identical properties such as colour, brightness and texture and that of different components must be dissimilar.

The degree of dissimilarity among every pair of components (pixels) can be computed using graph cut. An Image segmentation can be represented in form of graph cuts which is defined as follows:

$$\mathrm{cut}(A, B) = \sum_{u \epsilon A, v \epsilon B} w(u, v) \tag{1}$$

In the above equation u and v corresponds to the vertices of two distinct components A and B. During the process of image segmentation, we face some problems such as noise, blurriness, which can cause difficulty in understanding of contents of an image. Therefore, perfect solution to image segmentation is very tough to attain. Hence, it is more suitable to solve these taskusingthe optimization techniques. The optimization technique formulates the image segmentation task by minimizing the conventional benchmark, however one can find precise or nearby precise solution to the problem with respect to visual perception. To achieve this, the concept of bi-partite graph can be taken as the optimal solution which minimizes the cut value of Eq. (1).

The correlation between graph cuts and the parallel vertex labelling is shown in Fig. 1, in which a graph is segmented by two cuts and there for has 3 labels at the final stage of segmentation.

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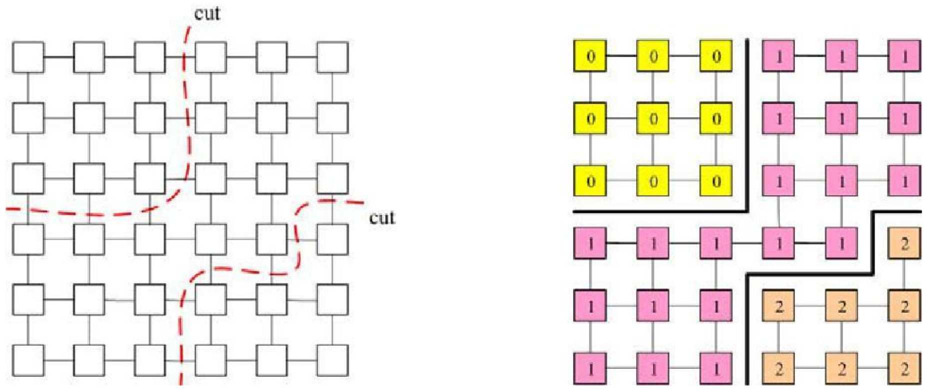

(a) Graph cuts (b) Labelling

Figure 1: An illustration of graph cuts and the equivalent vertex labelling. (a) A graph in which vertices corresponds to image pixels and is called 4-neighborhood system. Graph cuts split the graph into three sub-graphs. (b) A labelling denoted by the symbol $L_p \epsilon \{0,1,2\}$. Thick lines correspond to cuts.

GRAPH-CUT WITH COST FUNCTIONS

3.1 Minimal cut methods

The concept of graph-cut for weighted graph was initially recommended by Leahy and Wu [5] in 1990 for image segmentation. Graph-cut based technique retain a distinguishing property in which a generic framework for optimally partitioning the graph is represented comprehensively. Different cost functions can be designed for developing different applications using this segmentation technique. Eq. (1) gives a chance for a meaningful definition of graph partitioning which is called as Graph cut. Here by minimization of cut results in dissimilar vertices for different sets.

3.2 Normalized cut methods

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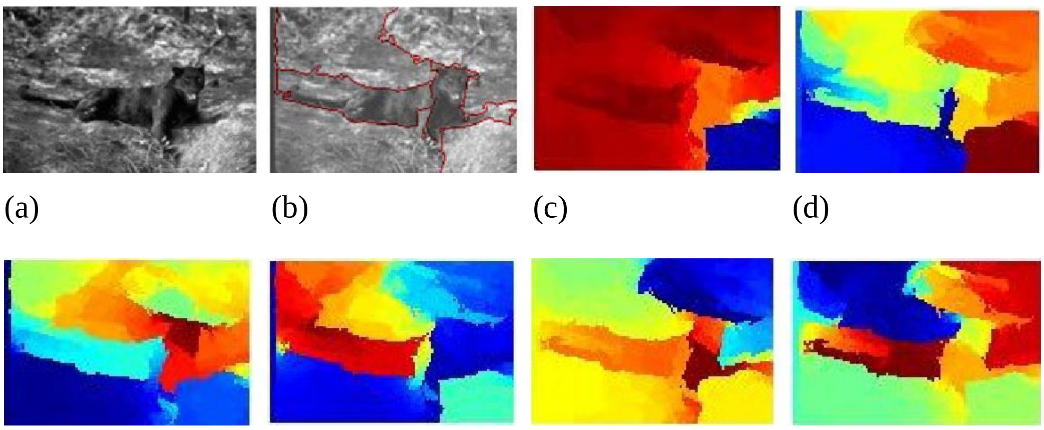
This method is spontaneous to exemplify the idea of Gestalt principle. Nevertheless, it has a bias to find small components. In order to solve this problem, several trainings conducted to discourse this problem, which lead to several normalized objective functions. Properly we have $vol(A) = \sum_{v_i \in A, v_j \in B} W(v_i, v_j)$, in which weight $W(v_i, v_j)$ computes image quantity such as intensity, texture and colour among the two vertices connected by the respective edge. The cost function for Ncut is defined as following.

$$Ncut(A,B) = \frac{cut(A,B)}{vol(B)} + \frac{cut(A,B)}{vol(A)} \quad (2)$$



(e) (f) (g) (h)

Figure 2:(a) Original Image, (b)-(h) Results of Ncut segmentation algorithm.

To overcome this drawback, the new cost function named mean cut [7] was presented by Wang et al. which discourses the problem by introducing an edge-weight function, which is as follows:

$$Meancut(A,B) = \frac{cut(A,B)|w(u,v))}{cut(A,B|1)} \quad (3)$$

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In the above equation, $cut(A,B)|w(u,v))$ is the cost of cut in between the regions A and region B provided that the weight of edge $w(u,v)$ and $cut(A,B|1)$ is defined correspondingly by considering the weights of all edges are equal to 1. This cut cost function reduces the standard edge weight in the cut boundary by the guarantee that every partition is associated. The disadvantage of this function of cost is that the average cut criterion does not openly present the bias on the preference for large object regions or smooth boundaries.

This technique accepts values of mean cut and relates to the average similarity per length unit of the boundary as an alternative of the mean similarity per element pixel of the boundary cut. The Ratio cut function is computed as follows:

$$Rcut(A,B) = \frac{cut_1(A,B)}{cut_2(A,B)} \quad (4)$$

Here in the above equation $cut_1(A,B)$ is the unit weight of one kind of iteration and $cut_2(A,B)$ is of the other iteration. Both are defined on the graphs concept.

Algorithms	Functional	Optimization method	Computational complexity	Bias
Minimal cut	$Mincut(A,B) = \sum_{u\in A, v\in B} w(u,v)$	Gomory-Hu's K-way maxflow algorithm	Polynomial time	Short boundary
Ncut	$Ncut(A,B) = \frac{cut(A,B)}{vol(B)} + \frac{cut(A,B)}{vol(A)}$	Solve the generalized eigensystem	$O(mn)$	Similar weight partition
Mean cut	$Meancut(A,B) = \frac{cut(A,B\mid w(u,v))}{cut(A,B\mid 1)}$	minimum-weight perfect matching	Polynomial time	No bias
Ratio cut	$Rcut(A,B) = \frac{cut1(A,B)}{cut2(A,B)}$	Baseline method	$O(n^{7/4})$	No bias

Table 1: Comparisons of four graph cut cost functions.

GRAPH-CUT ON MARKOV RANDOM FIELD MODELS

Markov random field theory denoted by MRF gives a valuable and reliable way of modelling background information such as features of image pixels like colour, texture.

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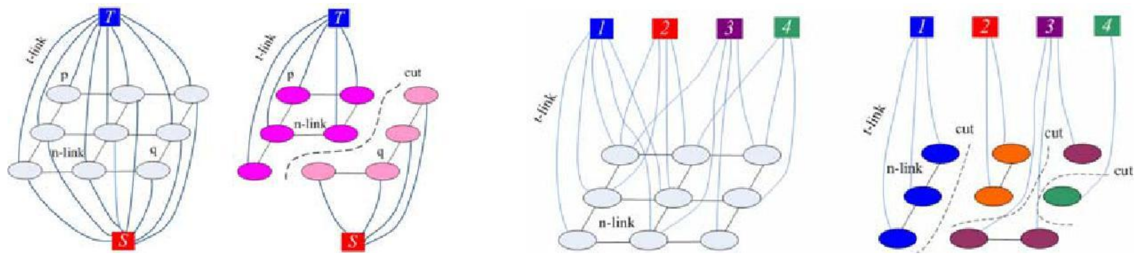
A graph-cut on MRF is a hybrid technique of optimization and is used as a tool for minimizing binary energies. It encompasses the concept of graph-cut interactive way. Therefore, the high-level information is incorporated in the segmentation process. The iterated methods based on graph-cut produce decent calculations and effective results. These techniques can be useful with images of low-level visual perceptions.

4.1 Bi-labelling graph-cut techniques

In graph-cut method, edges of E consists of two kinds of links in order to compute these two constraints which are links: t-links and the n-links. A partition in an image can be of two kinds. First kind is called as the object and the second is called background. This information is later modelled as two terminal visual nodes depending on the user input. This is shown in Fig. 3.



(a)A two-way cut (b)A multi-way cut

Figure 3: Graph-cut model with labelling. (a) A s/t graph-cut model. (b) A multi-label graph-cut model.

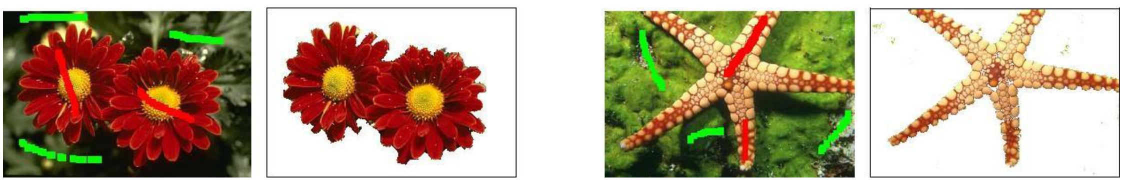


Figure 4: Illustrates above method, in which user interacts by giving the inputs objects seeds called as red strokes and background seeds called as green strokes.

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4.2 Multi-labelling graph-cut techniques

The s/t graph-cut method is used to find the optimal solution for definite class of energy functional. But, in most of the cases the number of labels for allocating to graph nodes is greater than two, and hence the energy minimization functions NP will become hard to compute. By introducing the spatial relationship among the objects of interest, the tough task of segmentation is overcome.

4.3 Interactive graph-cut methods

By the introduction this technique, an effective editing is permitted for the user for the betterment of results of segmentation. The lazy snapping [9] and Grabcut [10] are the two examples of this. In this method the user can position the seed points coarsely to specify the parts of the image which are objects and can alter the segmentation outcomes by modifying the boundary by using few soft constraints. Later a much innovative user interactive tool was introduced by Liu et al. [11], named as “Paint Selection”. It gives spot feedback to the users when they do select the area of interest using the mouse. The experimental results shows that the local optimization improves the segmentation quality, as in every step the algorithm catches user’s interactions to the maximum extent.

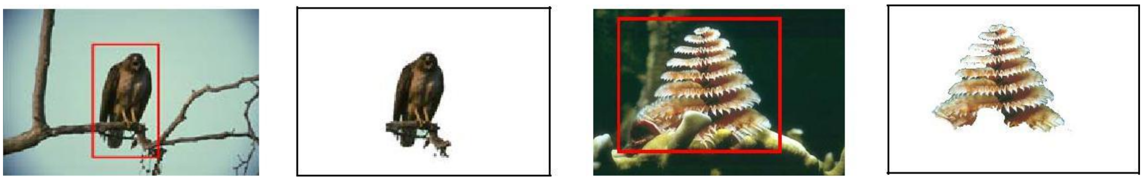

Figure 5: Experimental results using Grab-cut shows the user interaction (can see red rectangle).

SHORTEST PATH BASED METHODS

In graph theory getting the shortest path among the couple of vertices is a fundamental problem. For the weighted graph, the sum of all the edge weights which is minimum is the shortest path between the pair of vertices. Let s be the staring vertex and $t$be the ending vertex of a associated and graph G weighted. In this the main aim is to find a shortest path

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from s which we call it as source vertex to t which is called as destination vertex whose weights of sum of all the edges is minimum. Some algorithms are developed to solve this. The popular one is Dijkstra's algorithm [12]. At the end of every loop, the vertices in the Dijkstra tree to the shortest paths from s are found. During the process of finding the shortest path for image segmentation, the task of detecting the finest boundary segment is altered into the minimum cost between the paths of pair of vertices. Many applications show that with user interaction the image segmentation results are very useful and encouraging.

The livewire technique [13] is another example of getting the shortest path between a couple of vertices which permits the user to select the beginning point on the boundary. Later the boundary censorships approximately the object at a speed of real-time. One important thing is that the seed points can jump the gaps for getting continuous boundaries. Livewire method gives more accurate results for image segmentation process. One disadvantage of this method is that the user needs to put the seeds accurately nearer to the boundary. Fig. 9 demonstrations the image segmentation using livewire technique, in which the three seed points are drawn to monitor the segmentation process.

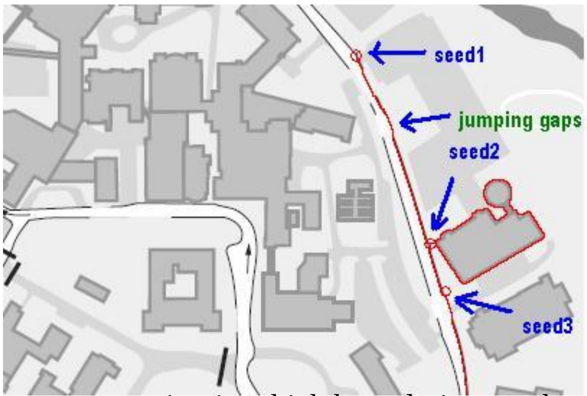

Figure 6: Livewire segmentation in which boundaries are shown in red colour. The blue lines indicate the three seed points.

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EVALUATION OF IMAGE SEGMENTATION METHODS

The most common way of evaluation is based on visual perception of the user. Nevertheless, it is time intense and may result in wrong outcomes by users. Therefore, it is important to evaluate segmentation results using quantitative methods. For this we use five important parameters; Probabilistic Rand (PR) index [14], Normalized Probabilistic Rand (NPR) index [14], Variation of Information (VI) [14], Global Consistency Error (GCE) [14] and Boundary Displacement Error (BDE) [14].

6.1 Probabilistic Rand (PR) index

The PR index measures the accuracy of segmentation using statistics. The segmentation of an image is expressed using binary numbers$\boldsymbol{I}(l_i^{sk} = l_j^{sk})$ for every pair of pixels (x_i, x_j).The PR index isdefined as follows:

$$PR(S_{test}, \{S_k\}) = \frac{1}{\binom{N}{2}} \sum \left[\left(l_i^{S_{test}} = l_j^{S_{test}} \right) + \left(l_i^{S_{test}} \neq l_j^{S_{test}} \right) \left(1 - P_{ij} \right) \right] \qquad (5)$$

For descriptions of the above equation refer [14].

6.2 Normalized Probabilistic Rand (NPR) index

The disadvantage of PR index is that it is tough to judge whether given score is good or bad. This can be solved by the introduction of expected value using NPR which is defined as follows.

$$NPR = \frac{Index - Expected\ Index}{Minimum\ \ Index - Expected\ Index} (6)$$

6.3Global Consistency Error (GCE)

It is used for calculating the degree of overlay of regions. It is introduced by Martin et al. [106].

The formula for computing GCE is as follows:

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$$E(S_1,S_2,p_i) = \frac{|R(S_1,p_i)/R(S_2,p_i)|}{R(S_1,p_i)} \qquad (7)$$

For descriptions of the above equation refer [14].

6.4 Boundary Displacement Error (BDE)

BDE is metric which is based on a boundary. It evaluates the quality of segmentation. It is defined as the distance from the pixel of one boundary and the closest pixel of another boundary of an image.

For much more details of BDE refer [14].

6.5 Variation of Information (VI)

It is defined as a distance metric as it fulfils the properties of symmetry, inequality of triangle and non-negativity. If any two segmentations are similar, the value of VI is zero. The upper bound of VI is finite. The formula for computing VI is as follows:

$$VI(S_{test}, S_k) = H(S_{test}|S_k) + H(S_k|S_{test}) \qquad (8)$$

For descriptions of the above equation refer [14],

This paper contains the survey of experiments which are conducted using the standard Bakeley dataset [15]. The following figure shows the generic images and their segmentation details with ground truths.

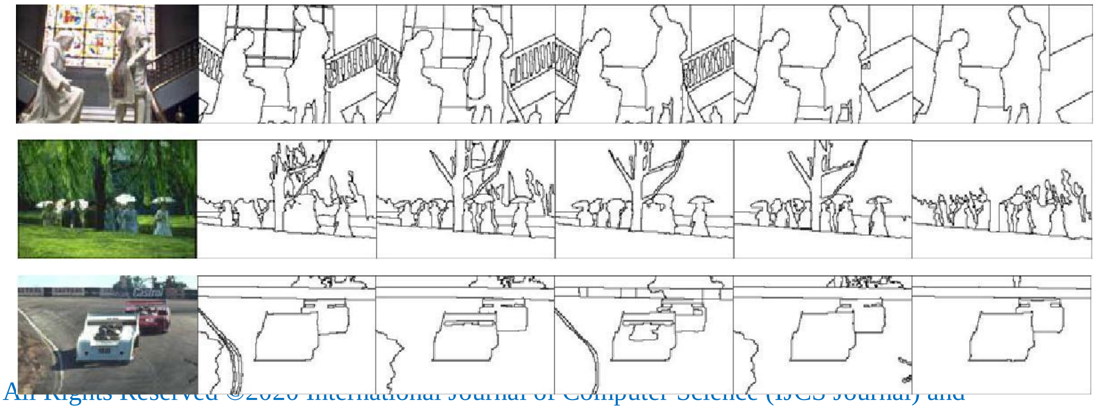

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Figure 7: Images and their segmentation with ground truth values [15].

The various graphs based methods and their evaluations using all the five indices i.e., PR index, NPR index, GCE, BDE and VI are explained in previous section.

BENEFITS IN MEDICAL IMAGE SEGMENTATION

From the last few decades the medical applications such as medical diagnosis, video, image retrieval and surveillance have mainly advanced from the graph based segmentation approaches. Even though these approaches are made for precise medical imaging fields, majority of these be categorized as in introduced. Medical imaging is comprised of numerical, material, and computational principles underlying modern medical imaging systems. Image segmentation plays a crucial role in medical imaging applications. Major applications include Computer-aided diagnosis and Computer-aided surgery. The images obtained in medical applications are quite complex and vary according to the modality used for Imaging. Broadly the familiar modules of medical imaging cover basics of X-ray radiography, computed tomography (CT), ultrasonic imaging, magnetic resonance imaging (MRI) and functional MRI (fMRI). The typical medical image obtained from any of the above modality is quite complex and difficult to interpret. Depending upon the modality used image for the imaging the medical image is put through various appropriate processing techniques to extract required data. The data collected from the image is vital in patient's treatment. The techniques of imaging and image processing are dependent on the type of Image as well as the final application for which the Image is being used. These techniques are depending on the ideas of the Fourier Transform, linear systems theory, optimization of numeric and so on.

CONCLUSION

We have thoroughly discussed three categories of approaches for graph-based image division. All these techniques use graphical concepts to implement. The concept of graph as a symbol

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of the image offers us an active way to study the task of image segmentation. All three types of graph based image segmentation methods uses five important indices namely PR index, NPR index, GCE, BDE and VI which plays a very important role in evaluation of the methods.

This paper aims to give the importance of graph based image segmentation techniques which will definitely help in future work on Magnetic Resonance Imaging (MRI) using the combinations of conventional, graph based and advanced segmentation techniques such as improved versions of watershed transformations, graph-cuts and fuzzy-logic techniques.

REFERENCES

[1] Ravindra S. Hegadi, Basavaraj A Goudannavar, "Interactive Segmentation of Medical Images Using GrabCut", IJMI, Volume: 3, Issue: 3, Pages: 168-171, 2011.

[2] G. Funka-Lea, Y. Boykov, C. Florin, M.-P. Jolly, R. Moreau-Gobard, R. Ramaraj, and D. Rinck. "An Automatic Heart Isolation for CT coronary visualization by GraphCut, In IEEE International Symposium on Biomedical Imaging (ISBI), pp.614-617, 2006.

[3] Hui Xue, Leo Grady, Jens Guehring and Marie-Pierre Jolly,"Combining Registration and Minimum Surfaces for the Segmentation of the Left Ventricle in Cardiac Cine Images of MR" Proc. of MICCAI. pp. 910-918, 2009.

[4] M. Wertheimer, "Laws of Organization in Perceptual Forms". A Sourcebook of Gestalt Psycychology, W.B.Ellis, ed., pp. 71-88, Harcourt, Brace, 1938.

[5] Z. Wu and R. Leahy, "Tissue classification in MR images using hierarchical segmentation". In Proc. IEEE Int. Conf: Medical Imaging.12(1):81-85, 1990.

[6] J. Shi and J. Malik,"Normalized Cuts and Image Segmentation", IEEE Transactions on Pattern Analysis and Machine Intelligence. 22(8):888-905, 2000.

[7] S. Wang and J.M. Siskind,"Image Segmentation with Minimum Mean Cut", Proc. Eighth International Conference Computer Vision, vol. 1, pp. 517-524, 2001.

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[8] S. Wang and J. M. Siskind,"Image Segmentation with Ratio Cut", IEEE Transactions on Pattern Analysis and Machine Intelligence, 25(6):675-690, 2003.

[9] Y. Li, J. Sun, C. K Tang and H.Y Shum,"Lazy Snapping", ACM Transaction on Graphics. 23(3):303-308, 2004.

[10] C. Rother, V. Kolmogorov and A. Blake,"Grabcut interactive foreground extraction using iterated graph cuts", In ACM Transactions on Graphics. 23(3):309-314, 2004.

[11] J. Liu, J. Sun, and H.Y. Shum,"Paint Selection", SIGGRAPH 2009.

[12] E.W. Dijkstra,"Some theorems on spanning subtrees of a graph",Indag. Math. 22(2): 196-199, 1960.

[13] A.X. Falcão, J.K. Udupa, S. Samarasekara and S. Sharma,"User-steered image segmentation paradigms: Live wire and live lane", In Graphical Models and Image Processing. 60: 233-260, 1998.

[14] R. Unnikrishnan and M. Hebert,"Measures of Similarity", Proc. IEEE Workshop Computer Vision Applications, 1:394-394, 2005.

[15] D. Martin, C. Fowlkes, D. Tal, and J. Malik,"A Database of Human Segmented Natural Images and Its Application to Evaluating Segmentation Algorithms and Measuring Ecological Statistics", Proc. International Conference, Computer Vision, 2:416-423, 2001.

[16] Basavaprasad B and Ravindra S. Hegadi, "A Survey on Traditional and Graph Theoretical Techniques for Image Segmentation", International Journal of Computer Applications (0975 – 8887) Recent Advances in Information Technology, 2014.

[17] G. Healey and D.K. Panjwani, "Markov random field models for unsupervised segmentation of textured color images", (PAMI), Volume: 17, Pages: 939-54, 1995.

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[18] Ravindra S. Hegadi and Basavaraj A. Goudannavar, "Tumor Segmentation from EndoscopicImages using GrowCut method", Communication Proceedings, Computation, Nanotechnology and Management (ICN), International Conference, Spetember-2011.