Minimum Spanning Tree Algorithm for Skin Cancer Image Object Detection

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Abstract

This paper proposes a new method Object Detection in Skin Cancer Image, the minimum spanning tree Detection descriptor (MST). This ObjectDetection descriptor builds on the structure of the minimum spanning tree constructed on the targettraining set of Skin Cancer Images only. The Skin Cancer Image Detection of test objects relies on their distances to the closest edge of thattree. Our experimentsshow that the Minimum Spanning Tree (MST) performs especially well in case of Fogginessimage problems and in highNoisespaces for Skin Cancer Image.

The proposed method of Object Detection Skin Cancer Image wasimplemented and tested on different Skin Cancer Images. We obtained very good results . The experiment showed that the proposedmethod obtained very good results but it requires more testing on different types of Skin Cancer Images.

Keywords

Image Segmentation ,minimum spanning tree, Skin cancer, , Object Detection, minimum spanning tree, Extraction of connected boundaries .

كشف الكائن في صورة سرطان الجلد باستخدام الحد الادنى من خوارزمية الشجرة الممتدة

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ملخص

تقترح هذه الورقة طريقة جديدة لكشف حدود الكائن في صورة سرطان الجلد، الحد الادنى من خوارزمية الشجرة الممتدة (MST) حيث يبني واصف كشف الكائن على هيكل من الحد الأدنى للشجرة الممتدةمن خلال مجموعة التدريب المستهدفة من صورسرطان الجلد فقط. تعتمد عملية الكشف على الكائن في صورسرطانعلى الاختبار من خلال الحصول على مسافات الاقرب الى حافة تلك الشجرة . بينتالتجارب أن شجرة الامتداد الحد الأدنى (MST) تؤدي بشكل جيد لا سيما في حالة ضبابية الصورة وفي صور سرطان الجلد التي تحتوي على ضوضاء عالي.

تم تنفيذ الطريقة المقترحة لكشف كائن صورة سرطان الجلد واختبارها على مختلف الصور سرطان الجلد . حصلنا على نتائج جيدة جدا. وأظهرت التجربة أن الطريقة المقترحة يمكننا من خلالها الحصول على نتائج جيدة للغاية ولكنه يتطلب المزيد من التجارب على أنواع مختلفة من صورسرطان الجلد .

الكلمات الرئيسية

تقطيع الصورة ، والحد الأدنى الشجرة الممتدة ، سرطان الجلد ، كشف كائن ، الحد الأدنى الشجرة الممتدة ، استخراج حدود متصلة.

1- Introduction

Image segmentation is a fundamental step in many applications of image processing. Skin cancer has been the most common of all new cancers detected each year. At early stage detection of skin cancer, simple and economic treatment can cure it mostly. An accurate segmentation of skin images can help the diagnosis to define well the region of the cancer[3]**.** Object detection is one of the great challenges of computer vision, having received continuous attention since the birth of the field. The most common modern approaches scan the image for candidate objects and score each one[3]**.**

This is typified by the sliding-window object detection approach ,but is also true of most other detection schemes (such as centroid-based methods or boundary edge methods). The most successful approaches combine cues from inside the object boundary (local features) with cues from outside the object (contextual cues. Recent works are adopting a more holistic approach by combining the output of multiple vision tasks and are reminiscent of some of the earliest work in computer vision [5]. Image segmentation is an important step in image analysis, pattern recognition, and computer vision. In radar images, for oil slicks detection, the segmentation is the main step for detecting the oil slick and defining its boundary. In mammography images, the segmentation is used to detect the region of the breast cancer . In skin images, the segmentation can detect the cancer regions. In this study, we will work on the segmentation of skin images in order to define the Object Detection of the skin regions. Many techniques exist for image segmentation based on different methods[1]. One of the most useful applications of the colour image segmentation is object detection [4] .

In many applications, knowing the color of a pixel subject to what extent such acts of human skin color is important in our algorithm easily and with great precision can be decided to these issues. also in spots where other parts of skin color with not skin color, they overlapped with membership degree of fuzzy criteria can accurately determine the skin color of a pixel or otherwise decided[2].

The rest of the paper is organized as follows: Section 2 gives a brief outline of the Minimum spanning tree (MST), Section 3 describes the process of building the System Design and summarizes the steps of our algorithms, Section 4 shows the experimental results obtained using our method. Section 5 gives concluding remarks.

2. Minimum Spanning Tree (MST)

The minimum spanning tree problem is one of the most famous combinatorial problems in computer science. A minimum spanning tree (MST) of a graph G = (V,E) is a minimum total weight subset of E that forms a spanning tree of G **where V=Vertices and G=Graph** . The MST problem has been intensively studied in the past since it is a fundamental network design problem with many applications and because it allows for elegant and multifaceted polynomial-time algorithms. In practice (on sequential machines and in internal memory), two simple algorithms dating back at least half a century still perform best in most cases[10].

Clustering by minimal spanning tree can be viewed as a hierarchical clustering algorithm which follows a divisive approach. Using this method firstly MST is constructed for a given input. There are different methods to produce group of clusters. If the number of clusters k is given in advance, the simplest way to obtain k clusters is to sort the edges of minimum spanning tree in descending order of their weights and remove edges with first k-1 heaviest weights [9]. The characteristics of affinity matrix and then define an optimization measure based on the weighted graph associated with an image. The solution to the optimization problem satisfies the clustering standard with maximal within-class similarity and minimum between-class similarity[8].

For random graphs with random edge weights, the MST edges are expected to be among the O(n log n) lightest edges. Note that this can even happen for random edge weights: Consider a “lollipop graph” consisting of a random graph and an additional path of length k attached to one of its nodes. The MST needs all the path edges, about half of which will belong to the heavier half of the edges for random edge weights[10].

3.System Design

The object detection problem can be seen as a classification problem, where we need to distinguish between the object of interest and any other object. In this paper, we used Minimum spanning tree (MST) to find object detection problem, detecting pedestrians in images [7]. Skin cancer is a disease in which cancer (malignant) cells are found in the outer layers of your skin. Your skin protects your body against heat, light, infection, and injury. It also stores water, fat, and vitamin D. The skin has two main layers and several kinds of cells. The top layer of skin is called the epidermis. It contains three kinds of cells: (flat, scaly) cells on the surface called squamous cells; round cells called basal cells; and cells called melanocytes, which give your skin its color[11]. The low level feature is the ridge characteristic called minutiae. These are the points of ridge ending(terminations) or branching[7].

Implementation, there are 3 main processes, that calculate of the distances between neighboring pixels, finding the Minimal Spanning Tree route, and deciding the output type (plain, edge, corner, or junction). Those three processes are done in a sliding window that the size is already defined, which is 3x3 mask. For that reason, the original input image matrix must be added with one pixel width on each side, so that the output of the pixels at the edge of the original image can be calculated.

The steps for Algorithm work is:

1- Start

2- Input skin cancer images

3-Find features minutiae points for skin cancer images

Point no.	x	y	Point direction

4- Find a relationship between extracted points to be used in the comparison between the images and sound infected Are drawing lines reach every point of the rest of the points (lines of network)

5- Intersecting lines has been canceled to generate the graph connecting points are extracted triangles

6- Great a new graph with information

Triangle no.	Vertex 1	Vertex2	Vertex3

7- Link the triangles is a graph is converted to tree

8- Prim's algorithm to find minimum spanning tree(short path)

9- Extraction of connected boundaries to segment the Skin Cancer Image.

10- After edge detection, all image pixels are divided into two sets; the Edge Pixel Set (EPS) and the Region Pixel Set (RPS). We move on to the region growing calculations.

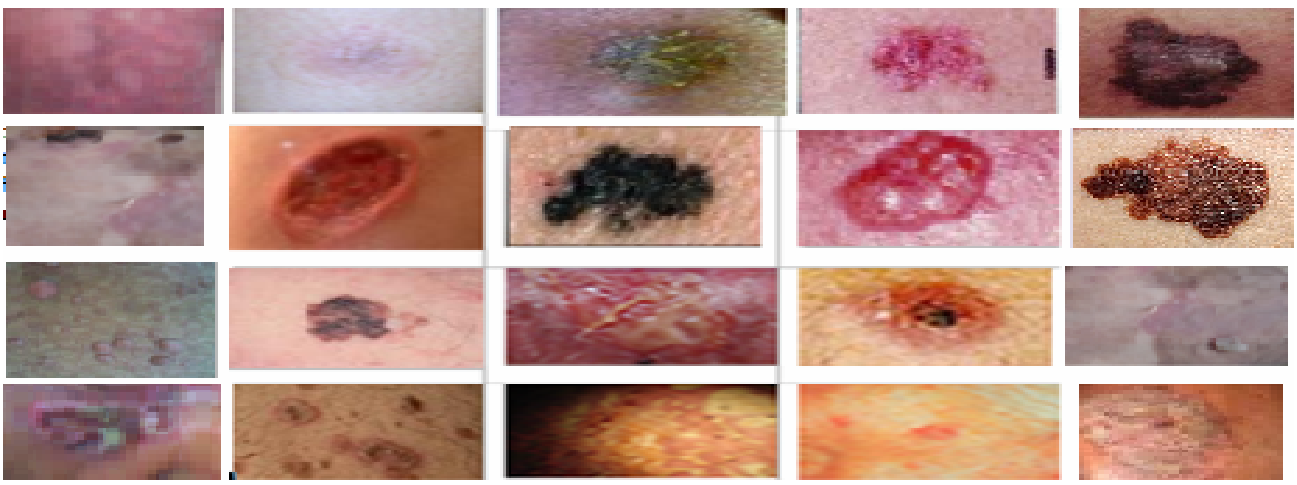
11-The detected edges cut the image into a set of regions. We pick a pixel from the RPS randomly as a seed for a new region, Ri. During region growing of Ri, all pixels in this region are moved out from the RPS and are assigned to this newborn region.

12- Region is fully grown, if the RPS is not empty, the algorithm simply picks a pixel randomly as a seed for another new region. This process continues until all pixels in the RPS are placed in a set of regions.
13- Find Boundaries Object Detection for Skin Cancer Image
14-End

4.Experimental Results

In this section a detailed experimental comparison of the above stated propose minimum spanning tree algorithm is capable of Segment with Extraction of connected boundaries for Skin Cancer Image Segmentation has been presented. We have used two types Mycosis Fungoides Skin image databases:

(1) database prepared in our conditions ,images obtained from in Al-Sder Hospital.
(2) Skin database [4] and some other images obtained from internet.



Figure(1): The skin cancer images library samples diseases

The experimental result of the first example is shown in figure(2) . The image used

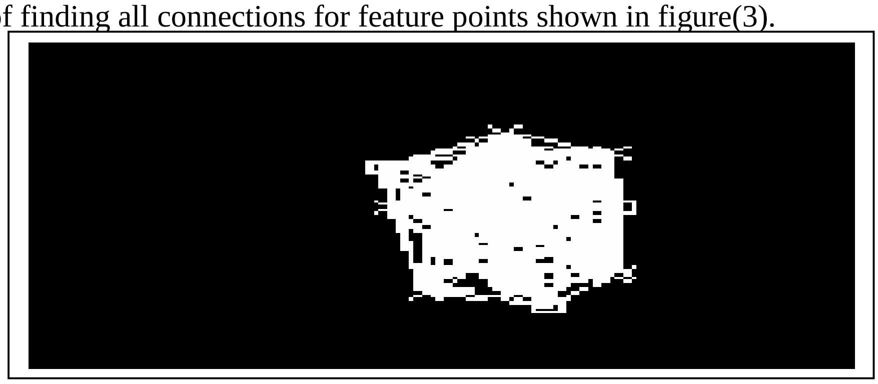
Figure(2): First example image

The values of image feature shown in table(1)

Table (1): The values of image 1 features

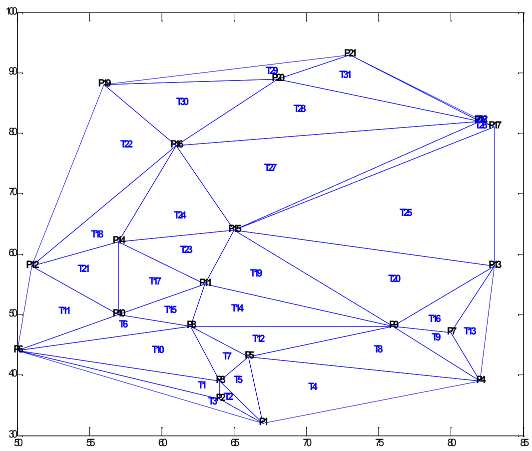
Point no.	x	y	Point direction
١	٦٧	٣٢	٠
٢	٦٤	٣٦	١٣٥
٣	٦٤	٣٩	٤٥
٤	٨٢	٣٩	٢٧٠
٥	٦٦	٤٣	٣١٥
٦	٥٠	٤٤	٢٧٠
٧	٨٠	٤٧	٣١٥
٨	٦٢	٤٨	٢٧٠
٩	٧٦	٤٨	٢٧٠
١٠	٥٧	٥٠	٢٢٥
١١	٦٣	٥٥	٩٠
١٢	٥١	٥٨	٢٧٠
١٣	٨٣	٥٨	٢٢٥
١٤	٥٧	٦٢	٢٧٠
١٥	٦٥	٦٤	٩٠
١٦	٦١	٧٨	٢٧٠
١٧	٨٣	٨١	٤٥
١٨	٨٢	٨٢	٢٢٥
١٩	٥٦	٨٨	١٣٥
٢٠	٦٨	٨٩	٩٠
٢١	٧٣	٩٣	٣١٥

The result of finding all connections for feature points shown in figure(3).



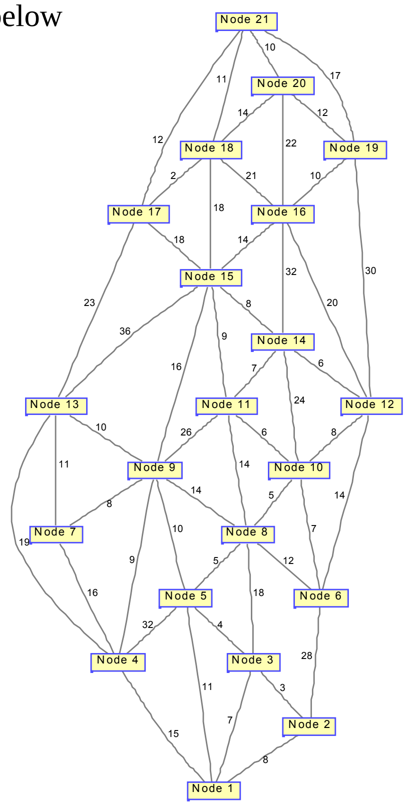
Figure(3): All connection for feature points

The values of resultant triangles shown in table(2).



Figure(4): Graph that show triangles after delete connections for image1

The resultant tree that connect features point shown below



Figure(5): Tree that connect features points

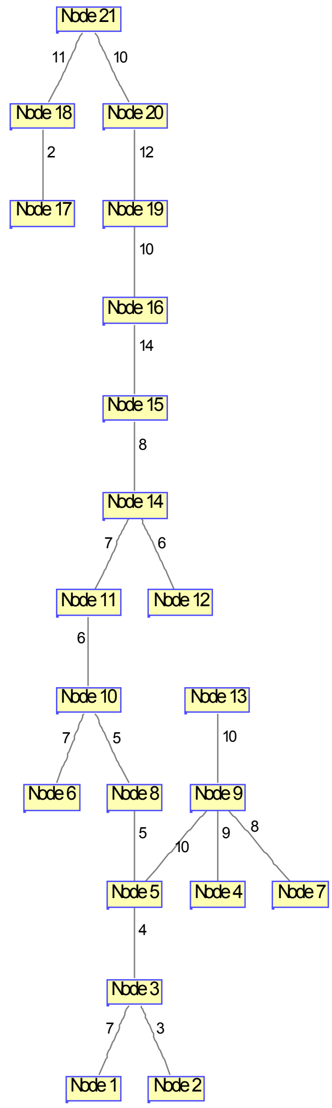
Table(2): Values of resultant triangles

Triangle no.	Vertex 1	Vertex2	Vertex3
1	٦	٢	٣
2	٢	١	٣
3	١	٢	٦
4	١	٤	٥
5	١	٥	٣
6	٨	١٠	٦
7	٥	٨	٣
8	٥	٤	٩
9	٤	٧	٩
10	٣	٨	٦
11	١٠	١٢	٦
12	٥	٩	٨
13	١٤	١٦	١٢
14	٩	١١	٨
15	٨	١١	١٠
16	٩	٧	١٣
17	١١	١٤	١٠
18	١١	٩	١٥
19	٩	١٣	١٥
20	٧	٤	١٣
21	١٠	١٤	١٢
22	١٦	١٩	١٢
23	١١	١٥	١٤
24	١٥	١٦	١٤
25	١٥	١٣	١٧
26	١٥	١٧	١٨
27	١٥	١٨	١٦
28	١٨	٢٠	١٦
29	٢٠	٢١	١٩
30	١٦	٢٠	١٩
31	١٨	٢١	٢٠
32	١٨	١٧	٢١

The resultant nods with their weights shown in table(3)

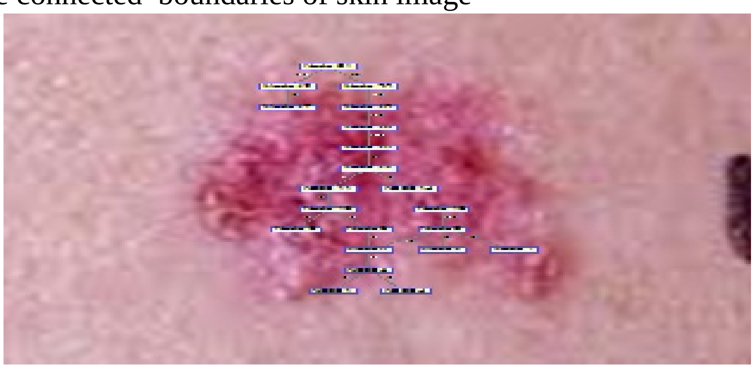
Table(3): weights MST for image1

Node	weight
(٣,١)	٧
(٣,٢)	٣
(٥,٣)	4
(٩,٤)	٩
(٨,٥)	٥
(٩,٥)	١٠
(١٠,٦)	٧
(٩,٧)	٨
(١٠,٨)	٥
(١٣,٩)	10
(١١,١٠)	٦
(١٤,١١)	٧
(١٤,١٢)	٦
(١٥,١٤)	٨
(١٦,١٥)	١٤
(١٩,١٦)	١٠
(١٨,١٧)	٢
(٢١,١٨)	11
(٢٠,١٩)	12
(٢١,٢٠)	١٠
(٣,١)	7



Figure(6): Minimum spanning tree (MST) for image 1

The value of path cost is (154)
Figure(7) shown in the connected boundaries of skin image



Figure(7):Connected boundaries of skin image

The growth of the regions must satisfy certaincriteria. If the criteria cannot be satisfied, the growth in the given direction will be stopped. A pixel is available only when it is contained in RPS. This means the pixel is not an edge pixel and has not been assigned to some other region yet. If any of these pixels is available and satisfies the criteria, the pixel is qualified to be a member of R. After addition of a pixel into region R, it will be a new boundary pixel of the region. The inner pixels and boundary pixels of the region are also required to update[10].

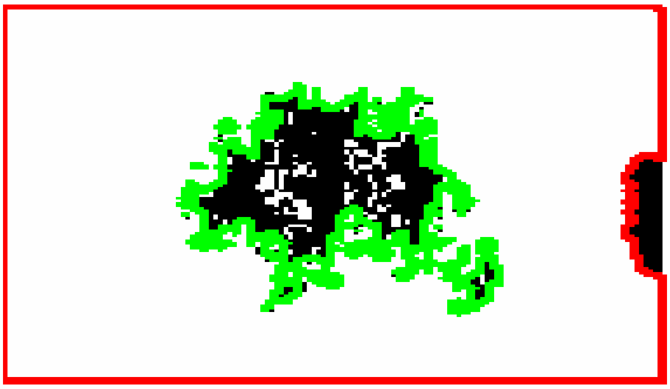
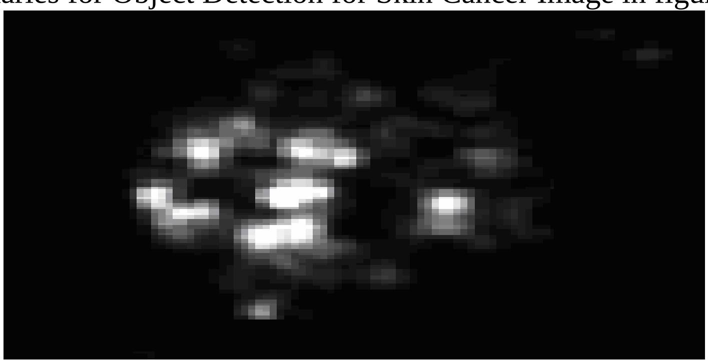


Figure (8): Region growing(Green : Boundary pixels of the region R,Block and white inside R: Pixels in the growing region R and White outside : Outer neighbor pixels of the region R)

Then find boundaries for Object Detection for Skin Cancer Image in figure (9).



Figure(9): Boundaries Object Detection for Skin Cancer Image

Last step is find Object Detection for Skin Cancer Image in figure(10)

Figure(10): Object Detection for Skin Cancer Image

7. Conclusions

This method differs from the previous experiences of difference through a combination of the following important points:

1- The way we incorporated between minimum spanning tree algorithm and Segment with Extraction of connected to complete the process of Skin Cancer Image Segmentation.

2- This method show the conversions that occur in Object Detection at each stage in implementation.

3- The new method reduced the time used basic points that represent graph using the local features minutiae points for each stage to extraction of connected boundaries .

New method using propose minimum spanning tree algorithm is capable of Segment with Extraction of connected boundaries for Skin Cancer Image Segmentation is proposed. We have proposed an automatic scalable object boundary detection algorithm basedon edge detection, and region growing techniques. We have also proposed an efficient merging algorithm to join adjacent regions using adjacency graph to avoid over segmentation of regions.

By identifying objects in images, we have shown that our approach works well when objects in images have less complex organization. Experiment results have demonstrated that the proposed scheme for boundaries works satisfactorily for different levels digital images. Another benefit comes from easy implementation of this method. This method is necessary to provide a robust solution that is adaptable to the varying noise levels of these images to help distinguish valid image contents from visual artifacts introduced by noise. The experimental results show the satisfying subjective test results and The simulation results are very promising.

References

[1] A. Dhawan, A. Huntley, L. X, M. Jackowski , Segmentation of skin cancer images, Image and Vision Computing 17,pp. 65–74, (1999).

[2] Ali El-Zaart, Skin Images Segmentation, Journal of Computer Science 6 (2): 217-223, 2010.

[3] A. Torralba, K. Murphy, and W. Freeman. Contextual models for object detection using boosted random fields. In NIPS, 2004.

[4] B. Somayeh Mousavi, Digital Image Segmentation using Rule-Base Classifier, American Journal of Scientific Research ISSN 1450-223X Issue 35 (2011).

[5] G. Heitz, S. Gould, A. Saxena, and D. Koller. Cascaded classification models: Combining models for holistic scene understanding. In NIPS, 2008..

[6] Lei Wang, Latifur Khan, and Casey Breen, Object Boundary Detection for Ontology-based Image Classification, Department of Computer ScienceUniversity of Texas at Dallas,2000.

[7] Luis Malago´n-Borja, Olac Fuentes , Object detection using image reconstruction with PCA, Image and Vision Computing (2007).

[8] Qiang He and Chee-Hung Henry Chu,Image Segmentation Using Maximum Spanning Tree on Affinity Matrix, Image Segmentation, The Center for Advanced Computer StudiesUniversity of Louisiana at Lafayette,2008.

[9] S.John Peter, S.P.Victor,A Novel Algorithm for Meta Similarity Clusters Using Minimum Spanning Tree, IJCSNS International Journal of Computer Science and Network Security, VOL.10 No.2, February 2010.

[10] Vitaly Osipov, Peter Sanders, and Johannes Singler ,The Filter-Kruskal Minimum Spanning Tree Algorithm, SIAM, Unauthorized reproduction of this article is prohibited,2007.

[11] http://www.south-seas.com/introto.html