Compare between A.H. SH Quintet mask and Ant Colony for Mycosis Fungoides Skin image Edge detection

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Abstract:

In this paper, in first stage Ant Colony Optimization (ACO) is introduced to tackle the image edge detection problem, where the aim is to extract the edge information presented in the image, since it is crucial to understand the image's content. The second stage .A.H. SH Quintet mask Appling for same images to find edge detection. The proposed approach exploits a number of ants, which move on the image driven by the local variation of the image's intensity values, to establish a pheromone matrix, which represents the edge information at each pixel location for Mycosis Fungoides Skin image Edge detection is proposed.

The third stage compare between first and second stage for Mycosis Fungoides disease. The Skin image have been identified and the edges of the images used for each and every stages that the database consists of 40 images divided each stage of the Mycosis Fungoides disease Skin image 10 images. For each stage a novel algorithm which combines pixel and region based color segmentation techniques is used. The experimental results confirm the effectiveness of the proposed algorithms .

Keywords:

ACO Edge detection ,Skin image detection, Segmentation, Image processing.

الملخص:

المرحلة الأولى في هذه الورقة تتكلم عن مستعمرة النمل المثالية (ACO) لكشفِ حافةِ صورةِ مرض جلدِ Mycosis Fungoides المُقتَرَحُ حيث إن الهدف من انتزاع محتوى الصورة هو فهم محتوى الصورة إما المرحلة الثانية تتكلم عن الماسك الجديد تحت عنوان (A.H. SH Quintet mask.) لنفس الصور وإما المرحلة الثالثة هي المقارنة بين المرحلة الأولى والثانية للحافات المنتزعة لنفس الصور حيث أنها . قدّمتْ إلى الأربعة مِنْ مراحلِ صورةِ مرضِ جلدِ Mycosis Fungoides مُيّزتْ وحافاتَ الصورِ استعملت لكُلّ مراحل التي قاعدة البيانات تَشْملُ 40 صورةِ قسّمتْ كُلّ مرحلة صورةِ جلدِ مرضِ صورِ Mycosis Fungoides الـ10. لكُلّ مرحلة لخوارزمية مبتكرة التي تَدْمجُ نقطةَ الشاشة والمنطقةَ أسندتَا تقنياتَ انقسام لونِ مستعملةُ. تُؤكّدُ النَتائِجُ التجريبيةُ فعالية المُقتَرَحينِ

1- INTRODUCTION

ANT colony optimization (ACO) is a nature inspired optimization algorithm motivated by the natural phenomenon that ants deposit pheromone on the ground in order to mark some favorable path that should be followed by other members of the colony. The first ACO algorithm, called the ant system, was proposed by Dorigo et al. [3]. Since then, a number of ACO algorithms have been developed such as the Max-Min ant system [5] and the ant colony system ACO has been widely applied in various problems. Research on a new meta-heuristic for optimization is often initially focused on proof-of-concept applications . In the early 1990s, ant colony optimization (ACO) [2]

was introduced by M. Dorigo and colleagues as a novel nature-inspired meta-heuristic for the solution of hard combinatorial optimization (CO) problems. Edge detection is an important field in image processing. It can be used in many applications such as segmentation, registration, feature extraction, and identification of objects in a scene. An effective edge detector reduces a large amount of data but still keeps most of the important feature of the image. Edge detection refers to the process of locating sharp discontinuities in an image. These discontinuities originate from different scene features such as discontinuities in depth, discontinuities in surface orientation, and changes in material properties and variations in scene illumination[1,2].

The boundaries of object surfaces in a scene often lead to oriented localized changes in intensity of an image, called edges[9]. This observation combined with a commonly held belief that edge detection is the first step in image segmentation, has fueled a long search for a good edge detection algorithm to use in image processing [3]. Edge detection of an image reduces significantly the amount of data and filters out information that may be regarded as less relevant, preserving the important structural properties of an image. Therefore, edges detected from its original image contain major information, which only needs a small amount of memory to store[4].

Edge detection produces something like a line drawing of an image, which highlights the intensity changes. In general, the boundaries of objects tend to produce sudden changes in the image intensity[5]. different surfaces of an object receive different amounts of light, which again produces intensity changes[6]. Edges are effected by noise present in an image though .An edge may be regarded as boundary between two dissimilar regions in an image .edge detection is a terminology in image processing and computer vision , particularly in areas of feature detection and feature extraction[7]. The paper is organized as follows; Section 2 deals with the Ant colony system is considered to determine the Mycosis Fungoides Skin image area. Section 3 deals with A. H.SH. Quintet mask, section 4 gives the overview of algorithm with Experimental Results and last section 5 ends the paper with conclusion.

2.Ant colony system

The ACO approach attempts to solve an optimization problem by repeating the following two steps:
• Candidate solutions are constructed using a pheromone model, that is, a parameterized probability distribution over the solution space;
• The candidate solutions are used to modify the pheromone values in a way that is deemed to bias future sampling toward high quality solutions[10]. Suppose totally K ants are applied to find the optimal solution in a space χ that consists of M1 × M2 nodes, the procedure of ACO can be summarized as follows[12]:

1-Initialize the positions of totally K ants, as well as the pheromone matrix $\tau^{(0)}$

2- For the construction-step index n = 1 : N,

For the ant index k = 1 : K,

- Consecutively move the k-th ant for L steps, Accordin1g to a probabilistic transition matrix $p^{(n)}$ (with a size of M1M2 ×M1M2).
- Update the pheromone matrix $\tau^{(n)}$

3- Make the solution decision according to the final pheromone matrix $\tau^{(n)}$ In a construction process, a set of artificial ants construct solutions from a finite set of solution components from a fully connected graph that represents the problem to be solved. A construction process contains a certain number of construction steps. Ants traverse the graph until each has made the target number of construction steps. The solution construction process starts with an empty partial solution, which is extended at each construction step by adding a solution component. The solution component is chosen from a set of nodes neighboring the current position in the graph. The choice of solution components is done probabilistically. The exact decision rule for choosing the solution components varies across different ACO variants. The most common decision rule is the one used in the original AS. On the construction process, the ant moves from node to node according to the transition probability , the probability that an ant will move from node to node (i.e., an ant in node will move to node). The AS decision rule is based on the transition probability given by:

$$p_{i,j}^{(n)} = \frac{\left(\tau_{i,j}^{(n-1)}\right)^{\alpha} (\eta_{i,j})^{\beta}}{\sum_{j \in \Omega_i} \left(\tau_{i,j}^{(n-1)}\right)^{\alpha} (\eta_{i,j})^{\beta}}, \quad \text{if } j \in \Omega_i \tag{1}$$

where is $\tau_{i,j}^{(n-1)}$ the quantity of pheromone on the edge from node to node ; j; $\eta_{i,j}$ is the heuristic information of the edge from node to node j; Ω_i is the neighborhood nodes for the ant given that it is at node ; and are constants that control the influence of the pheromone and heuristic information, respectively, to the transition probability :

$$\sum_{j \in \Omega_i} \left(\tau_{i,j}^{(n-1)}\right)^{\alpha} (\eta_{i,j})^{\beta} \tag{2}$$

The exact way by which the pheromone values are updated varies across different ACO variants. The AS pheromone update follows the equation:

$$\tau_{i,j}^{(n)} = (1-\rho) \cdot \tau_{i,j}^{(n-1)} + \sum_{k=1}^{K} \Delta\tau_{i,j}^{(k)} \tag{3}$$

where is $\rho \in (0,1]$ the pheromone evaporation rate; is the number of ants; $\Delta\tau_{i,j}^{(k)}$ is the quantity of pheromone laid on edge by the ant:

$$\Delta\tau_{i,j}^{(k)} = \begin{cases} \frac{1}{L_k}, & \text{if ant k used edge (i, j)} \\ 0, & \text{otherwise} \end{cases} \tag{4}$$

where is the tour length of the ant. The tour length is determined according to some user-defined rule. The rule depends on the nature of the problem to be solved, but it must always be such that desirable routes have smaller tour lengths. In general, the tour length is a function of the heuristic information associated with the edges belonging to the tour. ACS has three significant differences from AS. First, it uses a more aggressive decision rule, the so called pseudorandom proportional rule, which strengthens the exploitation of the search experience accumulated by the ants. Second, pheromone evaporation and deposit are done only on edges belonging to the best-so-far tour, as opposed to AS where pheromone evaporation is done on all edges and pheromone deposit is done on edges belonging to any solution constructed in the current iteration.

Third, each time an ant uses an edge to move from one node to another, it removes some pheromone from that edge to increase the exploration of other areas. The process of removing pheromones from edges as they are crossed is called local pheromone update. The local update counterbalances the effect of the greedy decision rule, which favors the exploitation of the pheromone information is normalization factor, which limits the values of within . Do Daemon Actions. Once solutions have been constructed, there might be a need to perform additional actions before updating the pheromone values. Such actions, usually called daemon actions, are those that cannot be performed by a single ant[10]. Normally, these are problem specific or centralized actions to improve the solution or search process. Update Pheromones. After each construction process and after the daemon actions have been performed, the pheromone values are updated[14].

On the other hand, each ant also increases the trial intensity on the way it has passed according to the quality of the solution found. This is a kind of positive feedback mechanism, which leads to fast solution searching by ACO [11]. The probability defined to move from state si to sj given by [13]:

$$p_{ij}(t) = \begin{cases} \dfrac{[\tau_{ij}]^{\alpha}[\eta_{ij}]^{\beta}}{\sum_{s_j \in \text{Allowed}} [\tau_{ij}]^{\alpha}[\eta_{ij}]^{\beta}}, & \text{if: } s_j \in A \\ 0, & \text{otherwise} \end{cases} \tag{5}$$

Where τ ij (t) is the trial intensity between si and sj at time t . Further, α and β are two parameters having positive values. η ij is the reciprocal of the distance between si and sj , which is the heuristic information. A is the set of neighboring states that have not been experienced by the current ant.
As we knew τ ij (t) is the trial intensity between si and sj at time t [10]. The trial intensity can be defined be equation (6):

$$\tau_{ij} = \left(\kappa_1 + \frac{\sigma}{\kappa_2 + \delta\sigma} \right) \quad (6)$$

Where σ implements pheromone released by an ant in transition from state i to j . Here k1 and k2 are constant factors, 1/δ implements sensory capacity, which describes the fact that each ant's ability to sense pheromone decreases somewhat at high concentrations. After all the ants finish the construction process, global pheromone update is performed on pixels that have been visited by performed on pixels that have been visited by at least one ant:

$$\tau_{i,j}^{(n)} = (1-\rho)\cdot\tau_{i,j}^{(n-1)} + \rho\cdot\sum_{k=1}^{K}\Delta\tau_{i,j}^{(k)} \quad (7)$$

Where $\Delta\tau_{i,j}^{(k)}$ is the amount of pheromone deposited by the k^{th}ant on pixel . The deposited amount of pheromone $\Delta\tau_{i,j}^{(k)}$ is equal to the average of the heuristic information associated

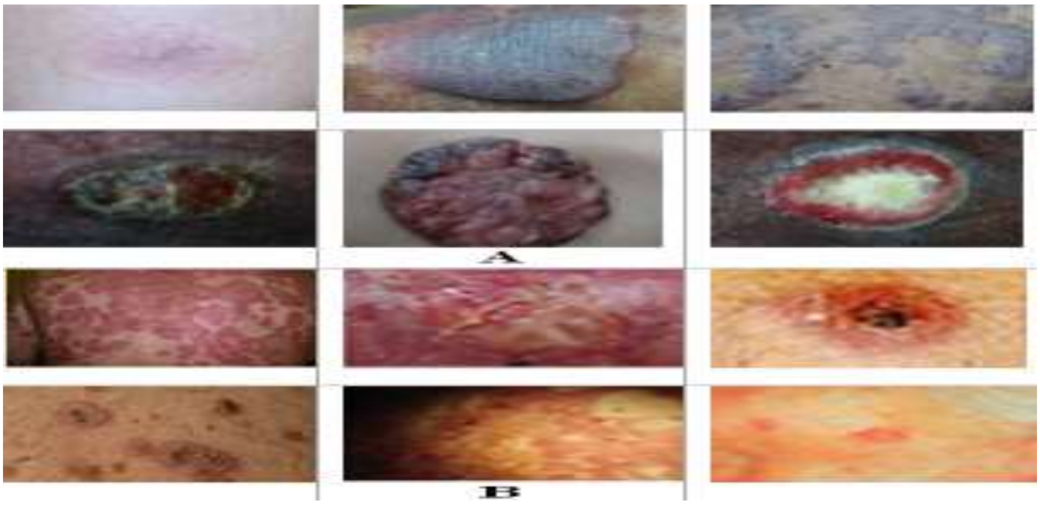
with the pixels that belong to the tour of the k^{th} ant if pixel (i,j) was visited by the k^{th} ant in its current tour; otherwise[11].Figure(2) shown edge detection for all Mycosis Fungoides Skin images which contain four steps .

3. A. H.SH. Quintet mask

A human skin color model is used to decide either a pixel is skin color or non skin-color[8]. In this research, we use mew method called(A. H.SH. Quintet mask) for Mycosis Fungoides Skin image edge detection . A. H.SH. Quintet mask consists of 5 rows *5 columns determines a characteristic direction edge. The Details of values for mask in A. H.SH. Quintet mask shown in figure(1) and the skin images library samples, two types of images (A)Samples with Mycosis Fungoides diseases Skin images (B) Samples with other diseases shown in figure(2).

√2	√2	√2	√2	√2
√2	√2	√2	√2	√2
√2	√2	√2	√2	√2
√2	√2	√2	√2	√2
√2	√2	√2	√2	√2

Figure(1): A. H.SH. Quintet mask



Figure(2): The skin library samples, (A) Samples with Skin diseases (B) Samples with other diseases

4.Experimental Results

In this section a detailed experimental comparison of the above stated A. H.SH. Quintet mask 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.
Mycosis fungoides is a T-cell lymphoma of the skin. The disease is caused by the proliferation of T-lymphocytes, also known as helper T cells[8]. In this paper divided stages images as Stages in mycosis fungoides(10 images for each stage)

Stage 1

The cancer only affects parts of the skin, which has red, dry, scaly patches, but no tumours. The lymph nodes are not larger than normal.

Stage 2

Either of the following may be true:
• The skin has red, dry, scaly patches, but no tumours. Lymph nodes are larger than normal, but do not contain cancer cells;
• There are tumours on the skin. The lymph nodes are either normal or are larger than normal, but do not contain cancer cells.

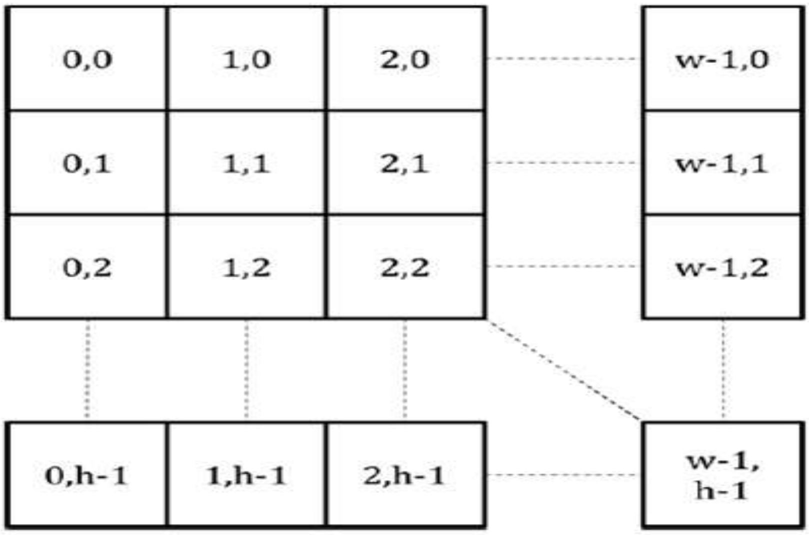
Stage 3

• Nearly all of the skin is red, dry, and scaly. The lymph nodes are either normal or are larger than normal, but do not contain cancer cells.

Stage 4

The skin is involved, in addition to either of the following:
• Cancer cells are found in the lymph nodes;
• Cancer has spread to other organs, such as the liver or lung[8]. Experimental Results for Appling Edge Detection mask shown in figure (2). There are five different criteria that are typically used for testing the quality of an edge detector:
-The probability of a false positive (marking something as an edge which isn't an edge)
-The probability of a false negative (failing to mark an edge which actually exists)
-The error in estimating the edge angle
-The mean square distance of the edge estimate from the true edge
-The algorithm's tolerance to distorted edges and features such as corners and junctions (Criteria taken from [2]) However, in order to determine the third and fourth criteria, an exact map of the edges in an image must be known, and in general this is not available. It is also not plausible to

assume that some "exact map" of all the edges can even be constructed. Therefore, the third and fourth criteria are not very useful. Additionally, corners and junctions simply are not handled well by any edge detector and must be considered separately. Therefore the fifth criterion is not very useful either. Image edge detection can be thought of as a problem of identifying the pixels in an image that correspond to edges. A w × h two-dimensional digital image can be represented as a two dimensional matrix with the image pixels as its elements.



Figure(3):Matrix representation of an image

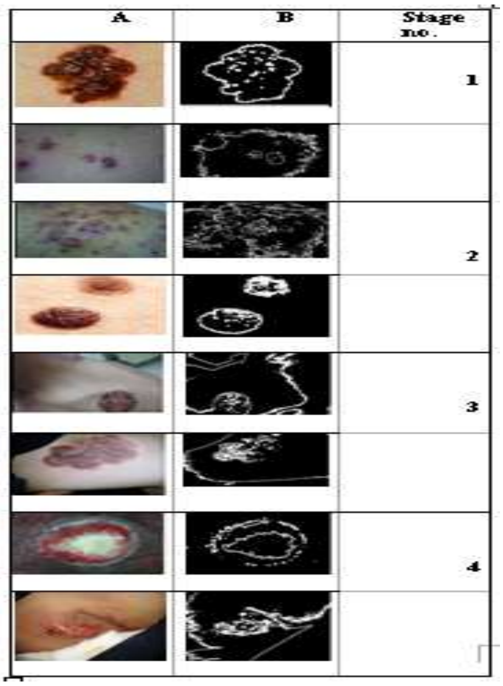
Where the operators values in our program are:

1- Alteration=0,001
2- $\alpha = 1$
3- $\beta = 0.1$
4- $\lambda = 1$
5- L=40
6- N=4
7- $\epsilon = 0.1$
8- p= 0,1
9- Close interval [0,1]
10- Y= 0.05

The most important criteria are the first two, as it is much more important to have the proper features labeled as edges than having each edge exactly follow what would be considered the "ideal" edge or being able to handle special features such as corners and junctions. So for our evaluation, we only considered the first two criteria[14].

7. Conclusion

new method called (A.H. SH Quintet mask) and Ant colony algorithm for Mycosis Fungoides Skin image edge detector presented in this paper and compare between two method. The proposed comparison is decrease the computation time with generate high quality of edge detection. Experiment results have demonstrated that the proposed scheme for edge detection works satisfactorily for different levels digital images. Comparison for Mycosis Fungoides Skin images Edge detection are 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. A.H. SH Quintet mask -based image edge detection method that takes advantage of the improvements successfully implemented compare with ACO method. The proposed method produced acceptable results within reasonable amounts of time. Subjective analysis reveals that the new approach using A.H. SH Quintet mask of edge detection is effective in all the three categories of the images selected. Edge detecting in an image significantly reduces the amount of data and filters out useless information while presenting the important structural properties in an image. Edge detection is difficult in noisy images since both the noise and the edges contain high frequency content. Better results can be obtained by applying a noise filter prior to the edge detection. Also the study is carried out with limited images, and additional tests and statistical investigations are necessary. The experimental results show the satisfying subjective test results and The simulation results are very promising..



Figure(4):(A):Original Skin Image ,

(B) Edge detection by A. H.SH. Quintet mask for all Mycosis Fungoides Skin image stages and last column is number stage

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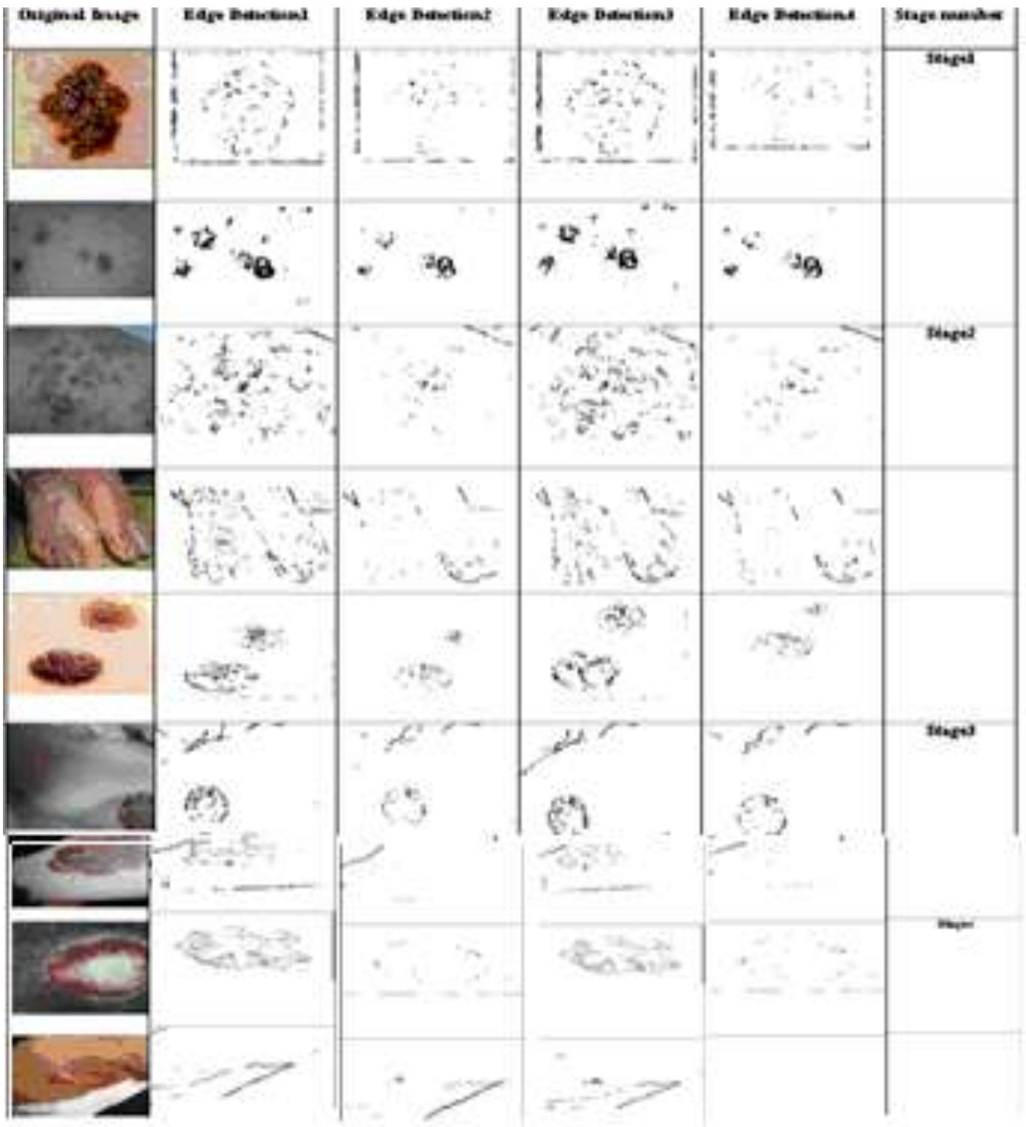

Figure(5): Original Skin Image ,
Edge detection steps by ant colony and last column is number stage