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Image Edge Unmasking by Applying Renovated Ant Colony Optimization Technique

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Abstract: Edge detection is a fundamental problem in image analysis. Ant Colony Optimization is also an evolutionary optimization technique, which has been applied to this problem. The proposed ACO-based edge detection algorithm represents the edge pixel position of the image using a pheromone matrix in which the movements of the ants driven by the image's intensity values are recorded. The RMSE and PSNR Values has been computed of existing algorithm and proposed algorithm with visualization concepts. Series of simulation research demonstrate the feasibility, effectiveness and superior performance of the proposed approach as compared to basic ACO.

Keywords: ACO, Acquaintance, Edges, Pheromone, Shortest path.

I. INTRODUCTION

Edge detection refers to the extraction of the sides in a very digital image. It's a method whose aim is to spot points in a picture wherever discontinuities or sharp changes in intensity occur. This method is crucial to understanding the content of a picture and has its applications in image analysis and machine vision. It's sometimes applied in initial stages of laptop vision applications edge is vital important feature in a picture and carries important data regarding the objects gift within the image. Edge detection aims to localize the boundaries of objects in a picture and considerably reduces the quantity of knowledge to be processed. Edge detection and extraction is very crucial to recuperate data on the form, structure, and different very important characteristics of the image.

1.) Methods for Edge Detection

There are many methods for edge detection, but most of them can be grouped into two categories, search-based and zero crossing based. The search-based methods detect edges by first computing a measure of edge strength, usually a first order derivative expression such as the gradient magnitude, and then searching for local directional maxima of the gradient magnitude using a computed estimate of the local orientation of the edge, usually the gradient direction:

a. Gradient operator

Edge detection based on gradient operator. The edge is the place where image gray value is changing rapidly, so the method based on the derivation of the gradient operator is most widely used.

b. Laplacian operator

Edge detection based on the optimum operator. The gradient of the image edge is the maximum value, that is, the inflection point of the gray image is the edge. Detecting this point, whose second derivative is 0 is a way of edge detection, for example, Marr-Hildreth operator, Canny operator.

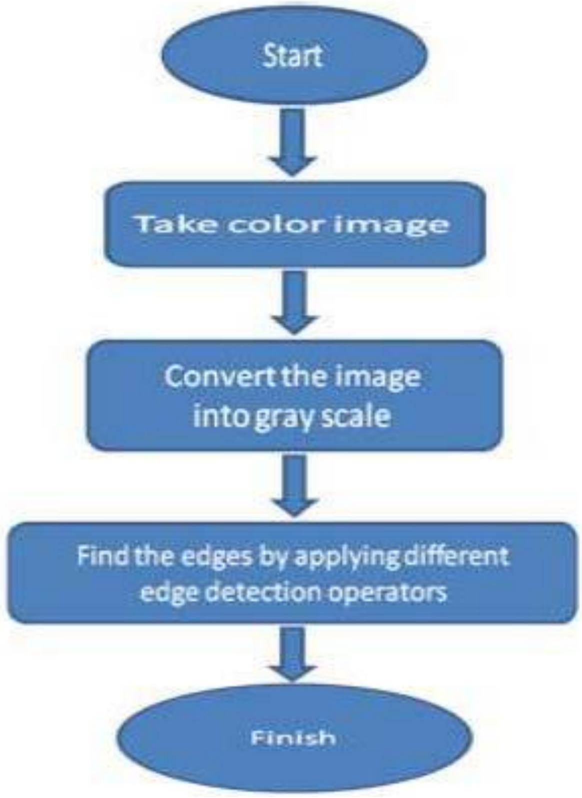

Figure 1: FLOW CHART FOR EDGE DETECTION

c. Multiscale edge detection

Wavelet transform is particularly suitable for signal mutation detection and edge detection. Rosenfeld suggested a combined consideration on the edge detected by multiple dimensions operator; Marr advocated applying multiple scales of different operators, and put forward some combination rules.

d. Edge detection based on 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

II. ANT COLONY OPTIMIZATION (ACO)

Ant Colony Optimization is a relatively new approach to problem solving that takes inspiration from the social behavior of the ants. ACO is a population based approach and is inspired by foraging behavior of ant species. In many ant species, ant walking to and from a food source deposit some substance on the ground called pheromone.. Ant Colony Optimization is an iterative algorithm. At each iteration, a number of artificial ants are considered. Each of them builds a solution by walking from vertex to vertex on the graph with the constraint of not visiting any vertex that she has already visited in her walk. At the end of an iteration, on the basis of the quality of the solutions constructed by the ants, the pheromone values are modified in order to bias ants in future iterations to construct solutions similar to the best ones previously constructed. Artificial ants are like real ants with some major differences:

1) Artificial ants have memory.
2) They aren't completely blind
3) They live in a discrete time environment.
However they have some adopted characteristics from the real ants, like
1) They probabilistically prefer path with a larger amount of pheromone
2) Shorter path is true path, larger is the rate of growth in the pheromone concentration
3)They communicate to each other by means of the amount of pheromone laid on each path.
The procedure of ACO can be summarized as follows:

a) Initialization procedures
for each iteration n = 1:N do
for each construction_step l = 1:L do
for each ant k = 1:K do
Select and go to next pixel
Update pixel's pheromone (local)
End
end
Update visited pixels' pheromones (global)
End

b) Construction process
In the nth step of construction, one ant being randomly selected from K total ants and this ant will move over the image for L steps. This ant will move from the (l, m) node to (i, j) node which is its neighboring node or pixel, is specified by the transition probability.

$$\rho^{(n)}(l,m),(i,j) = \frac{\left(\tau^{(n-1)}i,j\right)^{\propto}(n_{i,j})^{\beta}}{\sum_{(i,j)\in\Omega(l,m)}(\tau_{i,j}{}^{(n-1)})^{\alpha}\,(n_{i,j})^{\beta}}$$

Where τ i, j (n−1) is the pheromone value of the node (i, j), Ω(l,m) is the neighborhood nodes of the node (l,m), ηi,j represents the heuristic information at the node (i, j). The constants α and β represent the influence of the pheromone matrix and the heuristic matrix, respectively
The function Vc (Ii, j) is a function of a local group of pixels c (called the clique), and its value depends on the variation of image's intensity values on the clique c.

$$n_{i,j} = \frac{1}{z}V_c(I_{i,j})$$

c) Update Process
The pheromone matrix is updated in the update process after the two update operations. Each building block of pheromone matrix is modified as given in equation:

$$\tau_{i,j}{}^{(n-1)} = \begin{cases} (1-\rho).\tau_{i,j}{}^{(n-1)} + \rho.\Delta_{i,j}{}^{(k)}, \text{if } (i,j) \text{is visited by current} \\ \quad\text{kth ant} \\ \quad\tau_{i,j}{}^{(n-1)} \end{cases}$$

The second update is carried out after the movement of all ants within each construction-step according to

$$\tau^{(n)} = (1-\varphi).\tau^{(n-1)} + \varphi.\tau^{(0)}, \dots\dots\dots$$

d) Decision Process
The solution is based on the values in the final pheromone matrix. This is done to be able to classify each pixel as either an edge or a non-edge. Though, when it comes to analyzing the work carried out by the ant collective in image edge detection, a result showing various degrees in intensity values is just as good as a black and white declaration. In this step, a binary decision is made at each pixel location to determine whether it is edge or not. The decision is made by applying a threshold τ on the final pheromone matrix. Here the threshold value τ chosen to be adaptively computed.

e) Visualise Process
In this step, different values of the Si (ψ) parameter are applied to the above algorithm. Smaller the value of the phi parameter more edges the algorithm detects in the image. As we go on decreasing the value of the phi parameter, output of the given image becomes clearer but it should not be zero. The proposed algorithm is as follows:

a. Start Construction Process (Equation: 1)
b. Compute mean intensity of image from histogram, set T=mean (I).
c. Step 2: compute Mean above T and Mean below T using T from step a.
d. Adjusted the Parameters
e. Update Process (Equation 2)
f. Repeat step 2 if T(i)~=T(i-1)
g. Normalize the threshold to the range [i, 1].
h. Created Edged Output.

III. OBJECTIVES

There are many goals of the of the edge detection technique. In this paper we are going to apply the

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remodified ACO on the images for the edge detection whose main objectives are as follows:

- Renovated ACO algorithm is proposed for the proper take care of the problem of edge detection in the digital images.
- Enhanced ACO Algorithm is made in such a way that it manifolds the performance as compared to previous algorithms for the edge detection
- Renovated ACO's implementation to achieve best perception in images.

IV. PROPOSED METHODOLOGY

The proposed approach used is basically the alteration and conversion of the previously used ACO algorithm into a new refined and enlightened algorithm for the edge detection. New modified algorithm for ACO is introduced or accouterment the complications of tracking down the edges in the images. In this step we will implement the improved algorithm using MATLAB and then comparing the present algorithm with the altered one..

1. Study of the Existing Algorithms
2. Identify the Different methods.
3. Identify the issue and Apply improved technique of Edge Detection using ACO.
4. Obtain Edged.
5. Performance measure of method by calculating performance parameters such as PSNR (Peak Signal to Noise Ratio).

V. RESULTS

The number of experiments has been implemented and the histogram has been drawn of the input images and edge output images.

Figure 2: INPUT IMAGE

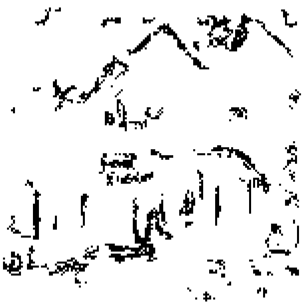

Figure 3: EXISTING ALGO OUTPUT

The Input images have been taken and edges will be improved. This image has been improved by the algorithm and shown in figure below. The different edges have been detected and can be identified directly. For accuracy measurements, the PSNR, values calculations has been measured.

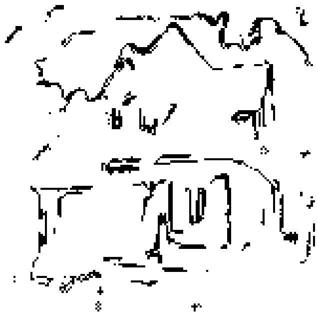

Figure 4: EDGE UNMASKING OUTPUT

Figure 5: INPUT IMAGE

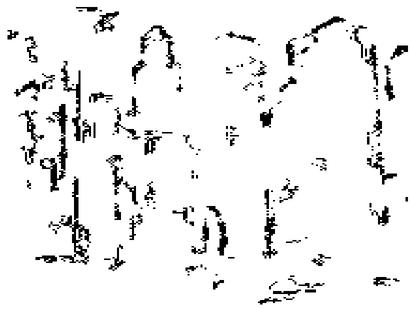

Figure 6: EXISTING ALGO OUTPUT

Figure 7: EDGE OUTPUT

Table 1: PSNR COMPARISON OUTPUT

INPUT	EXISTING PSNR	PROPSED PSNR
1	35.23180021	36.6317726
2	34.23451256	25.6578324

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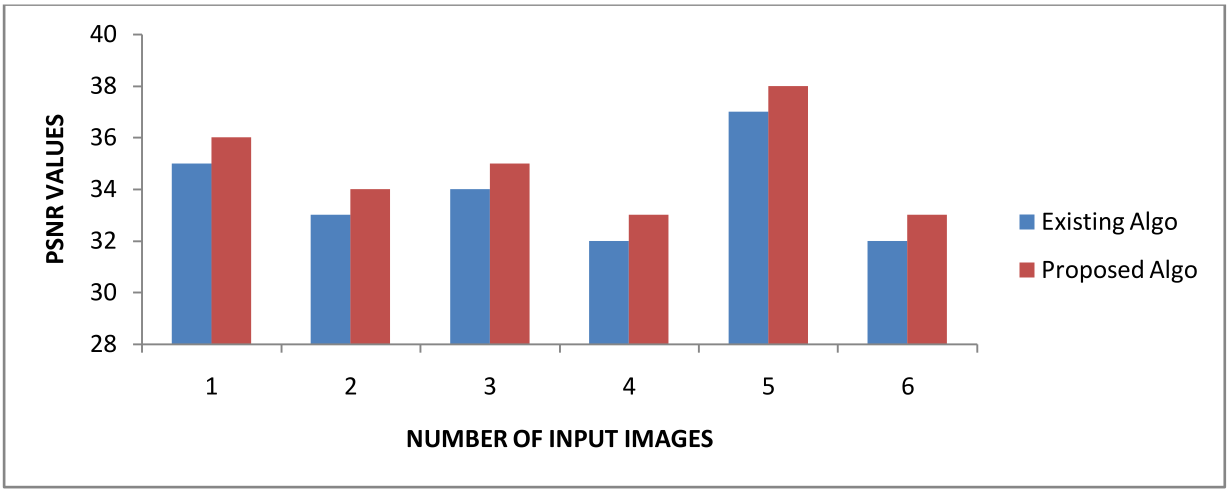

Figure 8: PSNR COMPARISON

VI. CONCLUSION AND FUTUREWORK

In this paper a modified ACO based image edge detection has been auspiciously cultivated. The proposed approach turnout to produce a remarkable performance as compared to the previously used algorithms for the disclosing of edges. By the use of modified ACO the perception of the images has also increased to a great extend. Researched results clearly show the superior performance of proposed approach with suitable parameters. The continuation research should concentrate on to reduce the computational time of the proposed approach and also on more effective way to calculate heuristic information.

In future we would try to increase the more accuracy of the edges and try to fetch the best performance. The ACO is applied in such a way that it will extract the attributes of images in a convenient way.

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