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Research Article

A SURVEY ON ADAPTIVE EDGE DETECTION TECHNIQUES USING ANT COLONY OPTIMIZATION TECHNIQUES

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ABSTRACT
The need to detect edges more efficiently leads to develop newer techniques and newer algorithms. The edges get more corrupt in noisy environment. So it becomes difficult to detect edges in such cases. So an approach that could develop edges with dense edge intensity needs to be developed. A review study is conducted where many techniques have been developed for the same purpose. In my proposed work, wavelets with higher order will be given as input to ACO. Then optimization algorithm ACO will be applied. Hence the smoothness of intensity of images and the density of edges will define the effectiveness of the proposed method.

Keyword: *Edge Detection, Ant Colony Optimization, Discrete Wavelet Transform, Density of Edges*

INTRODUCTION
Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. An image defined in the "real world" is considered to be a function of two real variables, for example, a(x,y) with a as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y). One of the fundamental applications of image processing is edge detection. Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. Edge detection is a fundamental tool in the areas of feature detection and feature extraction. The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. In real world, optimization techniques are needed to faster the processes. ACO algorithm has been the proposed method so far in detecting edges at a faster rate. Further input variables can be changed in ACO to have better results.

Related Works
One of the approaches used for edge detection is adjusted ant colony optimisation which uses canny or sobel operators as inputs to ACO for edge detection. The initial pherome was taken through matrix or edge image. Their movement and direction was also specified. Ants are not distributed through whole image but are divided into two groups. In the first one pheromone is distributed through the magnitude image pixels that are possible edges. Others will be distributed to other parts of image. In this way, chance of ants moving randomly is suppressed. Other ants play the role of recognizing all possible pixels of being an edge. The movement of ant is given by an equation and stops by death of an ant that occurs by arriving to one of its previous pixels. Upon reaching the next ant position a pheromone is updated. Image size reduction is introduced as a really effective method to noise reduction compared to previous method of image smoothness. In pheromone update process, a few parameters such as diameter and area of travelled path are converted into rules and rules are normalized to compute the final update value through averaging. The results found were much better than the traditional ACO algorithm (Davoodianidaliki *et al.*, 2013).
In an another approach edge detection of blurred images were done using ant colony optimization techniques In this proposed work non-prominent edges were not detected, only area of our concern is

noted, calculate its strength, importance and assign different strength values of edge pixels. Input images are converted to grey images. Strength value of a pixel is calculated as maximum variation in grayscale values between his own value and neighbourhood pixel values. Edge information for a particular pixel is obtained by exploring the brightness of pixels in the neighborhood of that pixel. Measuring the relative brightness of pixels in a neighborhood is mathematically similar to calculating the derivative of brightness. Brightness values are discrete, not continuous, so the derivative function has been estimated. The results found are much better than the previous results and edges were detected for normal as well as blurred images (Agarwal, 2013).

Another work that has been done so far uses discrete wavelet transform as input to ant colony optimization for edge detection. The algorithm used creates a pheromone matrix to stand for the edges of the low frequency component obtained from the DWT decompositions, according to the movements of a number of ants which are dispatched to move on the image. Furthermore, the movements of ants are driven by the local variation of the image's intensity values. The algorithm was applied onto the noisy images. The algorithm works better for noisy images (Muhammad *et al.,* 2013).

One of the approaches for edge detection is using Bi-Level histogram equalization of images. This approach for edge detection is based on Ant Colony Optimization (ACO), Bi-Level histogram equalization and also Brightness Preserving Dynamic Fuzzy Histogram Equalization. To enhance the image, firstly it is converted to grey image and then histogram is taken. This histogram is equalized for enhancement. Then ACO is applied for this equalized image. The results of ACO and histogram equalization are compared with the brightness Preserving Dynamic Fuzzy Histogram Equalization and found that the results are better than previous one based on brightness levels (Kavitha and Sudhamani, 2012).

Algorithm

The objective of this work is to capture the edges more effectively of an image. The work proposed here uses ACO for edge detection. The main objective is to increase the intensity of edges of an image. In the previous work done, the input is given through wavelet transform of lower order. The noisy image will not give effective edges on ACO. Hence before applying the optimization algorithm, noisy image will be smoothed out using wavelet transform. The main advantage of DWT is that it decomposes the image into sub bands giving a higher flexibility in terms of scalability in resolution and distortion. Hence the optimization algorithm will detect edges by continuing the edges and joining them if there is any breakage or if not visible clearly. The detailed description of the methodology will be as follows:

1. The input images will be taken as in the base paper (Muhammad *et al.,* 2013). These will be checked for the edge detection. Firstly Gaussian noise is added to the image.
2. These image will be given through discrete wavelet transform. Discrete wavelet transform will give the wavelets of the image and represent the whole image as frequency components. By using the wavelets, given function can be analyzed at various levels of resolution. The DWT is also invertible and can be orthogonal. When discrete wavelet transform of higher order or complex DWT will be applied to the input image then the whole image will represent the image as frequency domain. These will represent as the coordinates of the image points.
3. Then these transformed images are further applied onto the given algorithm.
4. ACO algorithm will be applied to the transformed image. In the natural world, ants (initially) wander randomly, and upon finding food return to their colony while laying down pheromone trails. If other ants find such a path, they are likely not to keep travelling at random, but to instead follow the trail, returning and reinforcing it if they eventually find food. Over time, however, the pheromone trail starts to evaporate, thus reducing its attractive strength. The more time it takes for an ant to travel down the path and back again, the more time the pheromones have to evaporate. A short path, by comparison, gets marched over more frequently, and thus the pheromone density becomes higher on shorter paths than longer ones. Pheromone evaporation also has the advantage of avoiding the convergence to a locally optimal solution. If there were no evaporation at all, the paths chosen by the first ants would tend to be excessively attractive to the following ones. In that case, the exploration of the solution space

would be constrained. Thus, when one ant finds a good (i.e., short) path from the colony to a food source, other ants are more likely to follow that path, and positive feedback eventually leads to all the ants' following a single path. The idea of the ant colony algorithm is to mimic this behavior with "simulated ants" walking around the graph representing the problem to solve.

5. Once the pheromone best position is taken, its position gets stored in the memory. Then the pheromone is updated for next values.
6. A global threshold is computed that converts the intensity of an image into a binary image.
7. Process in repeated until threshold value does not change any more.
8. The edges hence developed will be compared with the Base paper.

RESULTS AND DISCUSSION

The work that has been done till date on edge detection has given different results with different edge intensities. In adaptive edge detection using method where input is given through canny filter to ACO, initial pheromone was proposed which reduces the image size. In Bilevel histogram equalization method of edge detection, number of construction steps and iterations has been reduced which gave better clarity of edges. In the discrete wavelet transform based method of edge detection, dense edges were discovered using noisy images, where images were first converted to wavelet. Hence when we work on noisy images then edges become more blurred and distorted. So I propose a method which uses higher order wavelet transform as input to ACO for edge detection. The presented work is implemented using matlab 7.5. After comparison with the previous work done, I expect the results to be better.

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