International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 2s, 2025
https://theaspd.com/index.php

Ant Colony Optimization For Medical Image Analysis

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Abstract
A set of characteristic parameters pertaining to the image will be the result of the various suggested image processing methods and algorithms that process images using mathematical notations and operations that can take on any natural form, such as a signal that needs to be processed. Some of the methods include image edge detection, image enhancement and restoration, and image segmentation. It is vitally important to use these processing techniques to analyze and extract important information from images processed by certain medical imaging techniques that depict the inside of a body. The data generated by these medical imaging procedures is utilized for pathology, diagnosis, clinical research, and therapeutic interventions. Medical imaging procedures are now an essential component of physiology and biomedical research. If the information obtained from these photos is compromised in any way, the non-tolerance remains.
Keywords: *Medical Image Processing, Digital Imaging, ACO, optimization*

1. INTRODUCTION

Medical imaging is a computer graphics and vision method that uses object recognition to obtain images composed of items for necessary pre-processing for segmentation, reconstruction, and enhancement. Out of all the procedures and methods, a low-level image processing method like Edge Detection is essential since an image's edge comparatively clears up any ambiguity in the process of extracting the data needed for additional biopsies and diagnosis from a medical image [1]. The edge of an image is the outer edge of the item being sensed in an image captured during medical imaging, when the brightness levels of the object's intensity vary across the picture's boundary[2]. One of the main causes of death for women in the recent past has been identified as breast cancer. One of the trustworthy imaging methods for identifying cancers and their features early on is digital mammography. Research shows that early cancer detection is mostly dependent on screening [9]. CAD systems must increase their sensitivity and specificity in order to be useful for clinical usage, as they are designed to aid in the process of differentiating between benign and malignant tumors. Either the computer or the radiologist may extract features for CAD procedures. Many radiographic picture features are used by radiologists, who appear to extract and evaluate them instantly and simultaneously. The identification of clinically significant features is necessary for the development of approaches utilizing computer analysis techniques. The performance of the CAD system designed using soft computing approaches has been estimated in this thesis. The CAD system has been identified through the use of image augmentation, denoising, multi-objective genetic algorithm extraction of different feature sets, and multilayer backpropagation neural network classification with Ant Colony optimization taking particle swarm optimization into consideration. [3].

2. REVIEW OF LITERATURE

This algorithm's fundamental concept is based on how ants walk. With the aid of a pheromone left by the ants that came before them, all ants travel the same route. This pheromone is used by the ants that follow to determine their course. As a result, each ant builds a solution to the issue piece by piece. In a similar manner, each ant builds the edges of the supplied image through an iterative process [13]. A few incorrect edges are identified from the typical Ant Colony Optimization algorithm's findings [14]. The concept of using the previous iteration's output as the input for the subsequent iteration aids in overcoming this [10]. The output is superior than that of the standard Ant Colony Optimization algorithm because the iterations are improved. This is carried on until there is little change in the variations of later iterations [4].

The output of both the standard Ant Colony Optimization algorithm and the improved Ant Colony Optimization algorithm shows that sounds are detected in addition to nodules. Therefore, a logical procedure is used to detect lung nodules even more accurately. The logical ACO output is obtained by applying XOR to the improved ACO algorithm's last iteration output and its prior iteration output. The pheromone that ants leave behind is the basis for the ACO algorithm. The pheromone left by the preceding ants is used by the ants that come after them. Many false positives are left behind by the ACO algorithm. The edges of the image can be detected using the Variant ACO method, which lowers the frequency of false positives. The Ant Colony Optimization method was modified to create the Variant ACO algorithm. An additional edge-detected image's output is subjected to the variant ACO algorithm. [5].

3. MATERIALS AND METHODS

The methodology employed by ants in their journey from the source to the destination and back to their nests is mirrored in the algorithm, which relies on pheromone deposition concentrations as outlined in the Ant Colony Optimization algorithm [11]. This approach incorporates the shortest path criteria as a key metric within Critical Path Methodologies, alongside various factors such as computation time, cliques, energy partitions, and power factors to characterize our hybrid algorithm [6]. Additionally, we have introduced an algorithm that distinctly outlines the discrepancies between the planned schedules and those derived from previous studies. Furthermore, we propose a predefined shortest path, termed ABCP (As Built Critical Path), which is derived from the algorithmic schedules and optimizes computation time, ensures the shortest or best possible path, enhances energy definitions and partitions, and accounts for the evaporation rate of pheromone deposition, while also detailing the edges of the medical image [7].

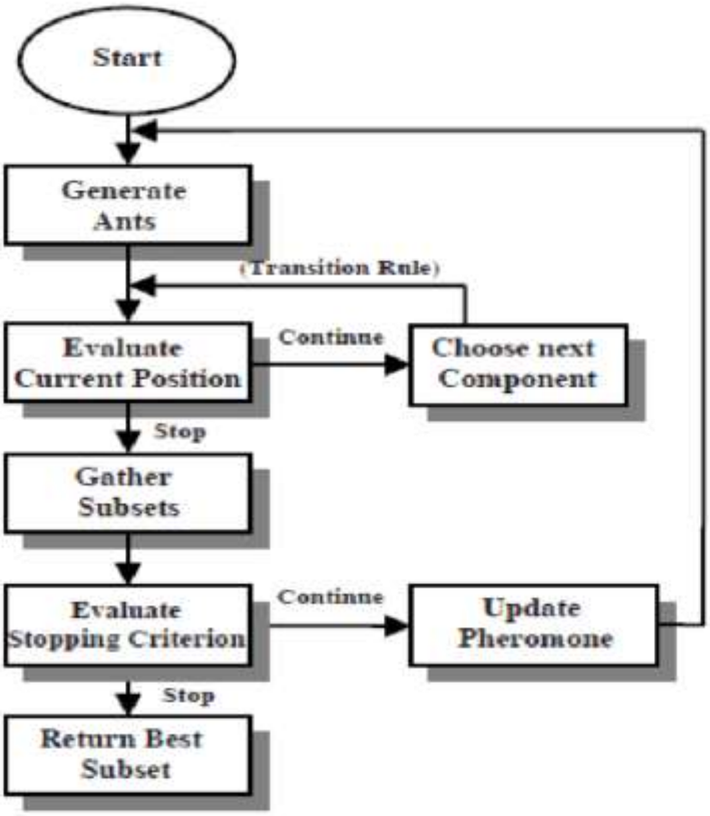

Figure 1: Flow chart

The proposed topology's effectiveness and implementation strategy were successfully tested through the development of an appropriate parallel algorithm and its corresponding environment[12]. Performance metrics, including speedup, execution time, and efficiency concerning time, memory, and logical implementation space for the algorithm, were assessed to distinguish between the applicable features and protocols necessary for their implementation and application [8]. These analytical findings are expected to demonstrate that the proposed parallel topology, which incorporates the exclusive hybrid methodology such as As-Built Critical Path (ABCP), is more reliable and efficient when considering routine operations and critical parameters for implementation [15].

4. RESULT

Among the numerous proposed techniques and algorithms for image processing, which utilize mathematical notations and operations applicable to any natural form akin to a signal that requires processing, the result will yield a set of characteristic parameters pertaining to the image.

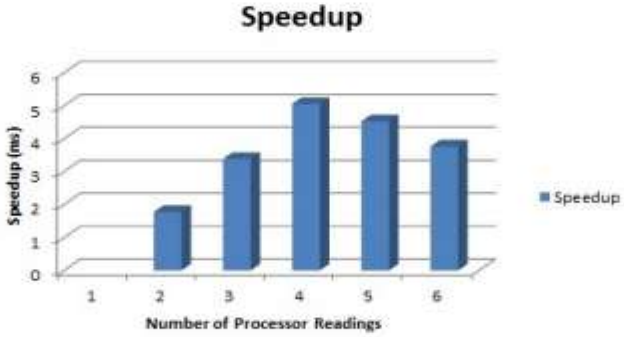

Figure 2: Speedup for 256 * 256 Image, 100 cycles, 1500 ants.

Techniques such as Image Segmentation, Image Enhancement and Restoration, and Image Edge Detection are included. Likewise, in the development of applications aimed at producing low bit rate images, coding the edges in relation to the intensity values is crucial, making edge detection a highly intelligible concept.

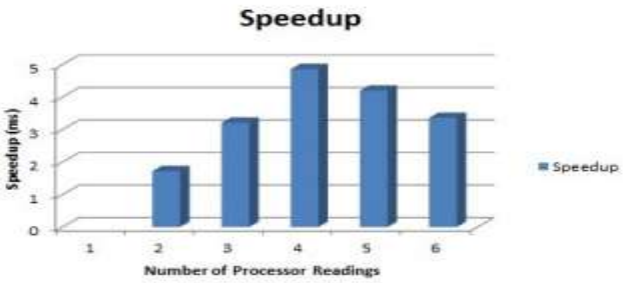

Figure 3: Speedup for 256 * 256 Image, 200 cycles, 1500 ants.

A boundary or contour indicates a significant alteration in the physical characteristics of a medical image, including surface normality, image depth, surface color and reflectance, illumination, or visible surface distances.

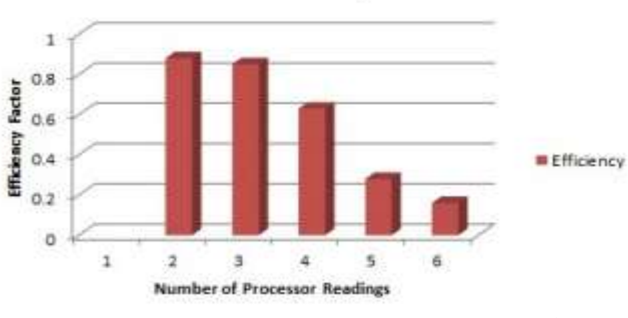

Figure 4: Efficiency for 256 * 256 Image, 100 cycles, 1500 ants.

The implementation of these processing techniques is crucial for the analysis and retrieval of vital information contained within images produced by specific medical imaging methods that depict the interior of the body.

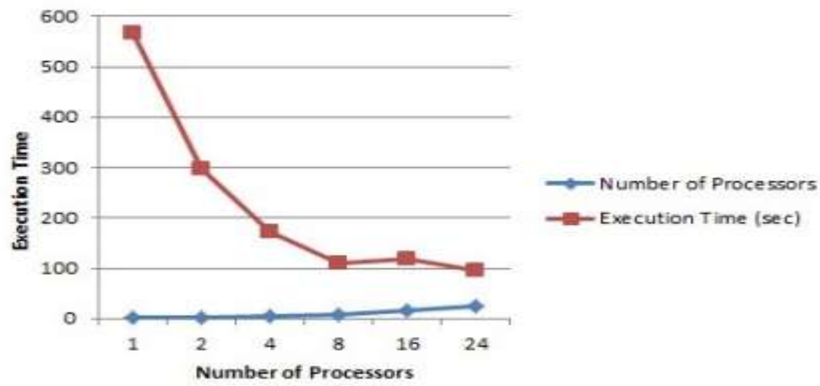

Figure 5: Execution time

The approximated image undergoes evaluation through the hybrid ABCP-ACO algorithm, which generates an acyclic graph represented by a series of arcs that correspond to the activities linked to the paths traversed by the ants in the image. These events are documented through the deposition of pheromones, a natural behavior exhibited by the ant population as they navigate the image in response to intensity variations at the edges.

5. CONCLUSION

Every proposed Algorithm aimed at addressing complex computational challenges, particularly NP-hard problems, must strike a balance between exploring and exploiting the search space. An inadequate balance may lead to the algorithm ceasing to discover effective solutions after a brief duration, becoming trapped in a specific area of the search space due to insufficient exploration, or failing to enhance solution quality because it cannot intensify the search in the current area to uncover the optimal solutions present there, necessitating further exploitation. The edges of an image contain vital information regarding the intensity values within the image. Detecting these edges aids in image segmentation, and retrieving edge information is essential for various research and analytical applications. The algorithm developed, implemented, and assessed in this chapter employs a meta-heuristic approach that addresses several critical parameters, providing detailed descriptions for each. It also highlights the differences from existing algorithms through the proposed As Built Critical Path ACO algorithm's managed metrics. This hybrid technique is applied to DICOM standard medical images obtained from various modalities, and experiments are conducted on medical diagnostic phenomena. The evaluation of the resulting qualitative metrics has demonstrated remarkable outcomes.

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