Comparison on the Performance of Genetic Algorithm and Ant Colony Optimization

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***Abstract*— Image segmentation is the technique in which an image into meaningful parts .It plays an important role in the image analysis and computer version. GA algorithm are evolutionary in nature so, it proved to be very time consuming. So, to overcome the limitation of the GA based on the multilevel thresholding, Ant Colony based Optimization on multilevel thresholding segmentation algorithm will be proposed. The overall objective is to reduce the time complexity of the genetic based segmentation. We also compare results of ACO and GA and tries to find which one gives the better solution in computational time.**

***Keywords*— Ant colony optimization, Genetic algorithm, Image segmentation, Multilevel thresholding.**

I. INTRODUCTION

Digital image processing is the use of computer algorithms to perform image processing on digital images. The digital image processing has many advantages over analog image processing. Image segmentation is most significant task in image processing is the middle layer of image engineering. Segmentation is important role of processing an image for dividing it into number of constituent regions or categories by assigning label to each and every pixel of an image which correspond to different objects or parts of objects so that each region may give information regarding an object or area of interest [1] and produces a binary image where pixel value "1" for object and "0" for background.

The better-quality segmentation is usually which one have:

1. Pixels belongs to same class have analogous grayscale of multivariate values and form a connected region.
2. Neighboring pixels of different categories have different values.

II. ANT COLONY OPTIMIZATION

Ant colony is said to be the probabilistic technique, which is used for solving the computational problems. They help in finding good solution to the problems. This is a Meta heuristic approach, which provides solution to the hard problem in the reasonable time. The reason why we use this technique is basically the foraging behavior of ants. Well now have a brief description about the working of the ants on basis of which this technique is based. The basic idea to be focused in this technique is that they chose any path and they think that path is optimum but when they actually find the optimum path then they replace old with the new one. Ants are almost blind but they still find out the shortest distance between their food and home without any visual sense. Ants follow one instinct which make them survive in any environment i.e. sociality. They cooperate with each other, communicate and divide their work they have ability to find way build nest and locating food supply. Thus this technique is adapted on the working behaviors' of ant.

A. Working of ACO

Step 1: Initialization: This is the initialization step in which we will determine population of ants which would be equal to the number of features.

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Step 2: Generation of ants: This step contains generation of ant. In this we will place one ant on each selected feature vector. This ant should visit all neighboring nodes and build the solution completely.

Step 3: Evaluation Criterion: In this step we will talk about the evaluation criteria. In this step we will make use of the Euclidean Distance among the features. Then we will compare the distance obtained with the stored image distance. In this we can assume that if the distance among the features meets the requirement with more than 40% deviation for all paths then we will exit.

Step 4: Stopping Criterion: In this step we will check the stopping criteria i.e. if ants have visited all features. Nodes/paths i.e. it reaches the maximum number of iteration allowed then we would exit otherwise we will continue.

Step 5: Pheromone updating: In this step we do the process of pheromone updating i.e. pheromone intensity. By doing this we will mark the path as verified and node as visited.

III. MULTILEVEL THRESHOLDING

Multilevel thresholding segments a gray level image into several distinct regions by detecting more than one thresholds. It is the easiest method for image segmentation used to create binary image from grayscale image by turning all pixels below threshold to zero indicate background object and all pixel above that threshold to one indicate foreground object.

IV. GENETIC ALGORITHM

A genetic algorithm (GA) is a search heuristic that mimics the process of natural selection. GA is used to finding solution to complex search problems. They are often used in fields such as engineering to create high quality products to their ability to search a through a huge combination of parameters to find the best match. They can also used to design computer algorithms, to schedule tasks and to solve other optimization problems [3]. Genetic algorithm is a part of soft computing a branch of computer science that deals with exploring the search space and select the best solution.

A. Working of GA

1. First step towards solving problem using genetic algorithm is the encoding of solution. In this stage, phenotype is mapped to genotype. It means data is represented in genes.

2. Take input parameter like population size, crossover probability, mutation probability, and number of generation for iteration.

3. Find the fitness value of each individual through fitness function.

4. Retainment of best fit individual and elimination of bad population is the task of selection.

5. Recombination is another name for crossover of two selected parents from the pool of population.

6. Mutation is adding new features form outside and permutation of gene within a chromosome.

7. Iterate steps 3 to 6 until terminate the loop.

8. Decode the final solution back to phenotype.

V. EXPERIMENT RESULTS

The proposed work has been tested on the grey scale images. In this “fig 5.1” shows that the original images and the results of output images after applying ant colony optimization and genetic algorithm. We observed these images are provides best results than GA technique. From the results of ACO we observed that the image intensity, colour, shape, visual quality is better than GA technique. Also, ACO are taken less time to selected the best solution or segmented region (object and background region).

“(a)”

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"(b)"

"(c)"

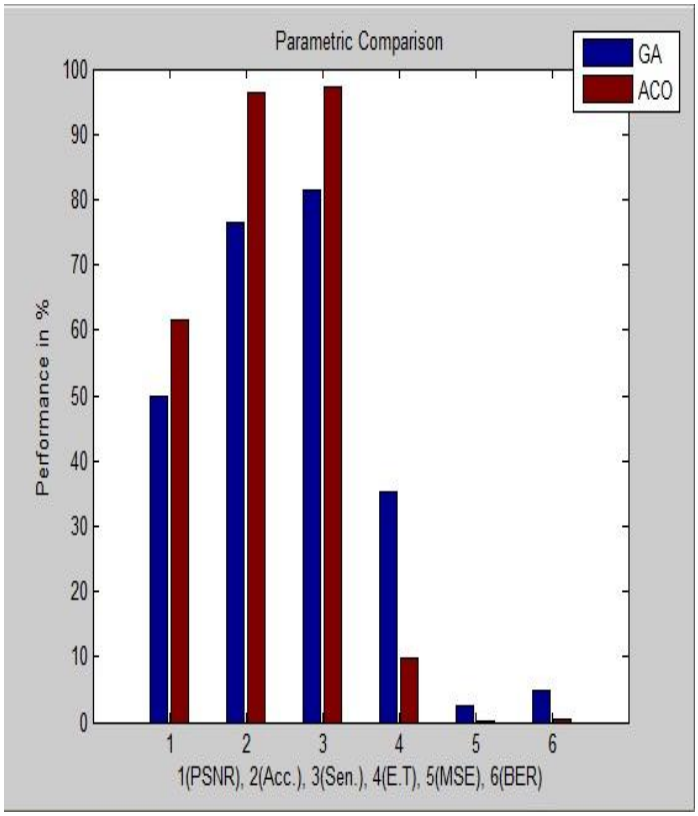
"Fig. 1" "(a)" Original Image "(b)" Segmented image using GA "(c)" Segmented image using ACO

In these results, Final output is to be given after applying ACO technique on original image, Best segmentation is cleared from figure 5.3 of our proposed method. Well, when we observe these images from different techniques. All methods gives different areas of segmentation depending upon image intensity, colour, shape etc. and results dissimilar segmentation depending upon their criterion. Thus, the visual quality and segmented regions present the superior performance of this proposed method where each and every background and foreground area segmented precisely than existing method.

The PSNR, Accuracy, Sensitivity, BER, MSE, Elapsed Time are evaluated. and the parametric comparison between GA and ACO which shows that PSNR 52%, Accuracy 75%, Sensitivity 76% is increased but elapsed time 9 sec, MSE 0.05 %and BER 0.5 % values have lower than GA.

Table 1: Parametric Comparison

Parameters	**(GA)**	**(ACO)**
PSNR	47.5636	52.7273
Accuracy	67.5388	75.2664
Sensitivity	43.311	76.560
Elapsed Time	35.3370	9.8950
MSE	2.5203	0.0057
BER	2.0280	0.5892



"Fig 2": Overall Performance of Existing & Proposed Technique

In this graph we can seen that the overall performance between existing and proposed technique. The value of PSNR 61%, Accuracy 96%, Sensitivity 98 %, Elapsed time only 9 second, MSE 0.05% and BER 0.5%. That means PSNR, Accuracy, Sensitivity is higher than existing technique (GA) and the value of elapsed time, MSE, BER is lower than GA technique. The proposed system is more

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accurate, sensitive and it takes less time, less error rate. So, ACO is better than GA.

The analysis results has shown that the long-established and more optimal ACO is very effective for feature extraction and evident from all analysis over different metric that ACO is better than GA method. At the end, Comparitative study between GA and ACO has shown that the Ant nature is effective among others. It is clear from results that it performs well on different sizes and formats of images. In close proximity to we can make new approaches by integrating the other extended techniques to enhance the results further by adjusting the over segmentation and edge detection problem in better way. Also the analysis of the parameters PSNR, Accuracy, Sensitivity, Elapsed time, MSE and BER provide better results of proposed technique than existing technique.

VI. CONCLUSION

In this paper, we have presented the comparative analysis of Ant Colony Optimization and Genetic Algorithm. The proposed work shoes that the ACO give better results as compare to the GA. This method appears to be good also in case of speed and reduction of over segmentation.

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