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A Review on Multilevel Thresholding using Genetic Algorithm and Ant Colony Optimization

Pardeep Kaur[1], Er. Neetu Gupta[2]

MTech Student, Dept. of ECE, Global Institute of Management & Emerging Technologies, Amritsar, India [1]

Assistant Professor, Dept. of ECE, Global Institute of Management & Emerging Technologies, Amritsar, India [2]

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. The genetic algorithm guarantees the local optimization but does not guarantees global optimization. The overall result depends on the selection of poor population may leads for poor segmentation. This paper has shown that existing segmentation tech suffers from various issues. So, to overcome the limitation of the GA based on the multilevel thresholding, in near future. 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.

KEYWORDS: Genetic algorithm, Ant Colony, Multilevel Thresholding, Population, Optimization.

I. INTRODUCTION

Image segmentation is the separation of an image into sections or groups, which correspond to various objects or division of objects. Every pixel in an image is assigned to one of a number of these groups. A good quality of segmentation is usually one in which pixels of similar category have similar grayscale of multivariate values and form an associated region and nearest pixels which are in different categories have dissimilar values. Basically, Image segmentation is the method of separating an image into several segments. The goal of segmentation is to make simpler or modify the representation of an image to some extent that is more important and not difficult to analyze. Image segmentation is generally used to find objects and edges (shapes, bends, etc.) in images. More accurately, image segmentation is the process of passing on a label to every pixel in an image in a way that all pixels with the same label split definite optical characteristics. The outcome of image segmentation is a collection of segments that mutually enclose the whole image, or a group of contours extracted from the image. Every pixel in a section is related with respect to a few features or figure property, such as color, strength, no roughness and no edging.

A.IMAGE SEGMENTATION TECHNIQUES:

There are different methods of Image Segmentation:-

(a) Thresholding: The easiest technique of image segmentation is the thresholding technique. This technique is carrying a threshold value to convert a gray-scale image into a binary image. The way of this process is to choose the threshold value once multiple-levels are chosen. An image is assumed to be divided into two parts: foreground and background. The interesting objects in the image are a foreground and the rest is a background. Threshold T is first finalized by analyzing all the pixel intensity.

(b) Histogram-Based Method: Histogram-based methods are extremely well-organized as evaluate to additional segmentation techniques since they normally want only single exceed in the course of the pixels. In this method, a histogram is figured from all of the pixels in the image, and the peaks and valleys in the histogram are used to establish the clusters in the image. The histogram can be prepared in several modes when various frames are measured.. The histogram can moreover be valuable on a per pixel basis where the information outcome is used to verify the most frequent color for the pixel location. This method segments support on dynamic objects and a static location and it's

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ensuing in an unusual kind of segmentation helpful in video tracking. Individual weakness of the histogram-seeking technique is that it might not be easy to distinguish important peak and valley in the image.

(c) Edge Detection: Edge detection is a strong field on its own inside image processing. Region boundaries and edges are directly connected, because there is frequently a quick adjustment in strength at the area boundaries. Edge detection algorithms have consequently been used as the base of another segmentation method. The edges recognized by edge detection are frequently detached. To segment a thing from an image through, one desires congested region boundaries. The desired edges are the boundaries between such objects or spatial-taxons.

(d) Region-Growing Method: Region-growing methods mostly rely on the statement that the adjacent pixels within individual region have related value. One region-growing process was the seeded region growing process. This process gets a group of seeds as input alongside through the image. The seeds stain each of the objects to be segmented. The regions are iteratively developed by evaluating all unallocated adjacent pixels to the regions. The pixel with the minimum variation calculated this way is appropriate to the respective region. This process carried on till then each and every one pixel is payable to a region. Because seeded region growing needs seeds as extra input, the segmentation outcomes are reliant on the preference of seeds, and noise in the image can reason the seeds to be weakly placed. A different region-growing process was the unseeded region growing process. It is an adapted method that doesn't involve clear seeds. At every iteration, it deliberates the adjacent pixels exactly the same like as seeded region growing. It fluctuates from seeded region growing in that if the smallest amount of δ is less as compared to predefined threshold T then it is added to the particular region.

(e) Split and Merge method: This technique begins at the root of the tree that signified the complete image. If it is created non-uniform (not homogeneous), then it is divide into four son-squares (the splitting process), and so on so onwards. On the other hand, if these son-squares are identical, they are able to be combined as a number of associated components (the merging process). The joint in the tree is a segmented joint. This process carries on self repeating until no extra splits or merges are achievable. Mainly in this method first the splitting of four disjoint quadrants is prepared.
(f) Compression-Based Method: Compression based methods propose that the best segmentation is the one that minimizes the general probable segmentations and the coding length of the data. The relationship between both concepts is that segmentation attempts to recover patterns in an image and any reliability in the image can be used to condense it. The system explains every segment by its texture and boundary shape.

II. RELATED WORK

Gopesh Joshi(2014) [1]: This paper presented an optimization technique. Although there are several optimization techniques like ant colony, simulated annealing, greedy approach and more yet genetic algorithm is meta-heuristics search optimization technique largely focus on overall optimization. And then we review various methods under genetic algorithm for optimization.

Qian Wang, Qi- peng zhang, Wei Zhou [2]: This paper presented a remote sensing image segmentation based on ACA-FCM. In this paper describe a remote sensing image based on the complexity of the background features, how to extract huge amounts of data in the region of interest is a serious problem. The traditional segmentation methods have obtained good results, but there are defects such as noise-sensitive, over- smoothing and loss of image information. Ant colony optimization algorithm is a fast heuritic optimization algorithm and it is robust. ACA- FCM can greatly enhance the speed of image segmentation, while reducing the noise on the image. The image segmentation based on ACA –FCM is carried out and compared with traditional methods. Experimental results show that ACA-FCM can quickly and accurately segment target and it is an effective method of image segmentation.

Yang, Xiaohui et al. [4]: This paper presented a method of image denoising, which is dependant on second generation bandelets and coupled with multi-level thresholding. Numerical tests applied on natural images contaminated additive Gaussian white noise show that their method provides an important improvement both in terms of image visual fidelity and in terms of peak signal-to-noise ratio. Comparisons are manufactured with wavelet image noise-removal results.

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Zhao, Yong et al. [6]: This paper employed a recursive programming technique which could reduce an order of magnitude for computing the MCET fitness function. Then, a quantum particle swarm optimization (QPSO) algorithm is proposed for searching the near- optimal MCET thresholds. The experimental results show that the proposed QPSO-based algorithm can get ideal segmentation result with less computation cost.

Ma, Junyong et al. [8]: This paper presented a new hierarchical segmentation method based on multilevel thresholding. The hierarchical segmentation utilized an iterative threshold selection method as a basis to partition an image into two regions. Similarly, every region is segmented into two parts. This process continues until a better segmentation is obtained. Several objective measures were considered to evaluate the quality of segmentation. The experimental results indicated the proposed method can obtain an effective segmentation for an image with more populations.

III. 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. 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. Main terms are gene, chromosome, individual, population. Gene is smallest unit of information carrying capacity. Continuous evaluation of and deletion of bad individual is what we are doing in genetic algorithm. Basic flow of genetic algorithm is given in figure 1. In figure 1 flow start from the generation of population. In the next step parent are select from the pool and reproduce to given children, this is known as crossover. Then these newly children are modified by the process known as mutation. They are evaluate against fitness criterion. Those children are selected that have high fitness value and become a part of population other that do not pass the fitness test are bad population and are deleted. The most comman type of genetic algorithm in which population is created with a group of individuals created randomly. The individuals in the population are then evaluated.

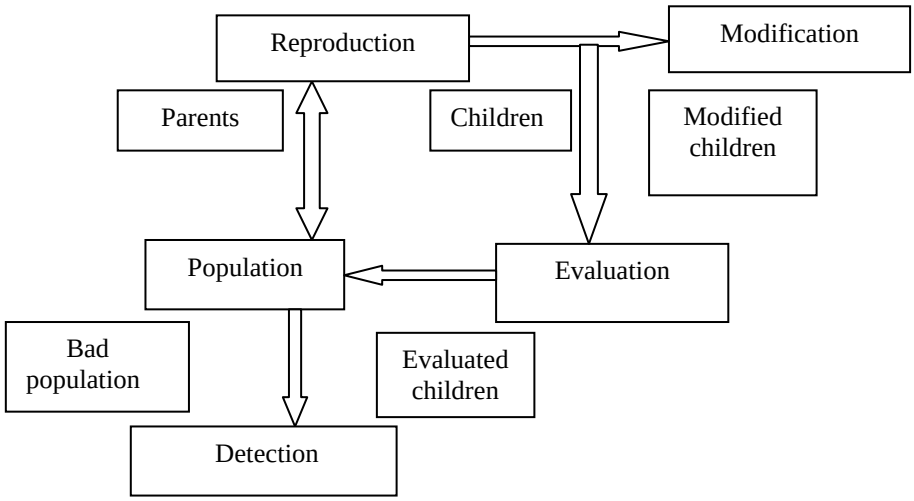

Fig.1. Working of Genetic Algorithm[1]

We are listing the steps involved in executing the genetic algorithm. There are 8 steps for the algorithm. Genetic Algorithm works as follows:

1.Encoding: 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.Initialization: Take input parameter like population size, crossover probability, mutation probability, and number of generation for iteration.

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

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4.Selection: Retainment of best fit individual and elimination of bad population is the task of selection.
5.Crossover: Recombination is another name for crossover of two selected parents from the pool of population.
6. Mutation: 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. Decoding: Decode the final solution back to phenotype.

IV. BASIC CONCEPT OF ANT COLONY OPTIMIZATION

The first ant colony optimization (ACO) called ant system was inspired through studying of the behavior of ants in 1991 by Macro Dorigo and co-workers [1]. Optimization problems can be solved through simulating ant's behaviors. Since the first ant system algorithm was proposed, there is a lot of development in ACO. To find the shortest way between the colony and a source of food, ants adopt a particular collective organization technique. Ants are capable of finding the shortest route between a food source and their nest without the use of visual information and hence possess no global world model, adapting to changes in the environment.

The probability that an ant chooses one path over another is governed by the amount of pheromone on the potential path of interest. With time, the amount of pheromone on a path evaporates. But the ants taking the shorter path will return to the nest first with food. The shorter pathway will have the most pheromone because the path has fresh pheromone and has not yet evaporated, and will be more attractive to those ants that return to the food source. Given that the pheromone trail evaporates over time, the trail will become less detectable on longer trails, since these trails take more time to traverse. The longer trails will hence be less attractive, which benefit to the colony as a whole.

Algorithm for ACO:
1. Ant traverse around the colony to find the food source
2. After finding the food source it returns to nest.
3. While travelling it deposit some amount of pheromone.
4. The followers of the first ant follow the pheromones which left by the first ant.
5. This transaction will make strengthen the deposition of the pheromone.
6. This strengthens the route of the ant in mean time the amount of pheromone will evaporate in each traversal.
7. If there are two routes to reach the same food source the ant find the shortest route between food and nest with the help of pheromone updating.

V. PROPOSED METHODOLOGY

In this section contains the flow chart of the proposed algorithm. Figure 2 shows the different steps of required is to reduce the time complexity of the genetic based segmentation through proposed algorithm.

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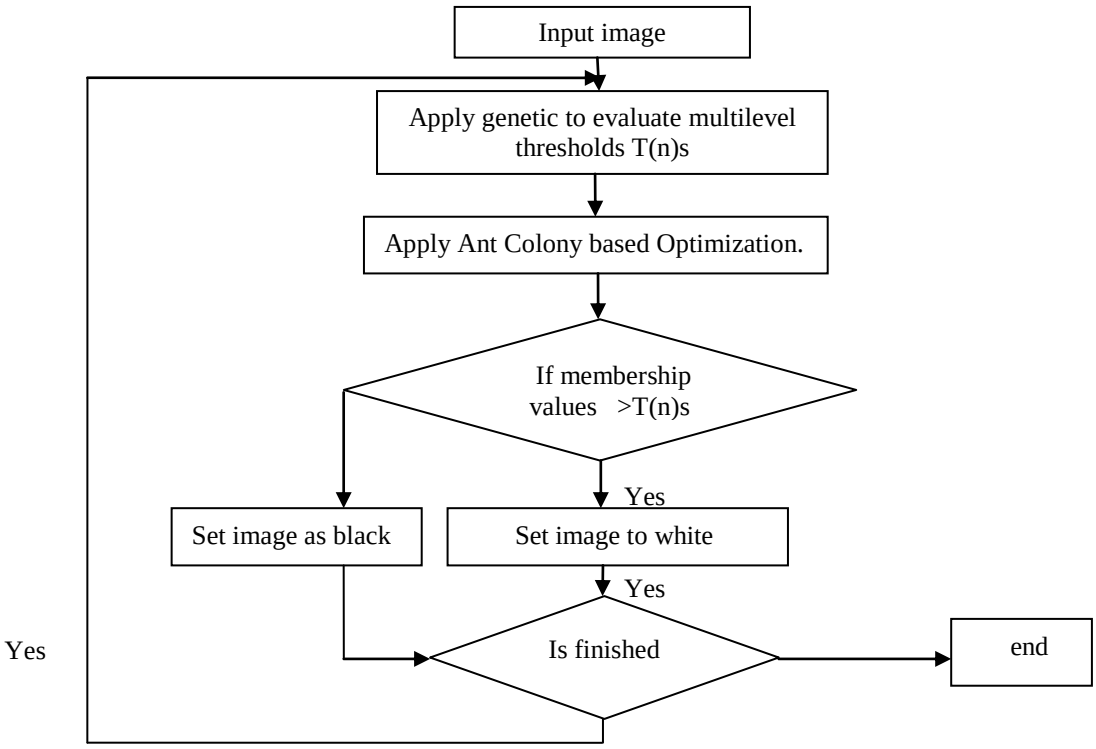

Fig 2: Flow chart of the proposed algorithm

VI. CONCLUSION

Ant Colony Optimization is used to migrate the problem of multilevel thresholding. But GA are evolutionary nature so, it proved to be very time consuming. The genetic algorithm guarantees the local optimization but does not guarantees the global optimization. So, the overall result depends on the selection of poor population may leads for poor segmentation. To overcome the limitation of the GA based on the multilevel thresholding. Ant Colony based Optimization on multilevel thresholding algorithm will be proposed.

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