Color Image Segmentation Using Particle Swarm Optimization in Lab Color Space

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***Abstract*— The color image segmentation is faced the problem of multidimensionality. Color image is considered in five dimensional problems, three dimensions in color and two dimensions in geometry. In this paper the, Lab color space conversion has been used to reduce the one dimension and geometrically it convert in the array hence the further one dimension has been reduced. The ab space is clustered using particle swarm optimization process, which minimizes the overall distance of the cluster which is randomly place at start of the segmentation process. The segmentation results of this method gives clear segments based on the color.**

***Index Terms*— Image Segmentation, Particle Swarm Optimization, Clustring, etc.**

I. INTRODUCTION

Image segmentation refers to the process of partitioning a digital image into multiple segments set of pixels. Pixels in a region are similar in according to some homogeneity criteria such as colour, intensity or texture. These pixels locate and identify the objects and boundaries in an image [1]. Image segmentation is a major Research topic in the field of Image processing. Most of the computer vision image analysis problem requires segmentation stage in order to detect objects and divide the image into regions which can be consider as homogeneous according to color, motion, texture etc. Practical application of image segmentation ranges from filtering of noisy images, medical applications (Locate tumors and other pathologies, Measure tissue volumes, Diagnosis, Treatment planning, Computer guided surgery, study of anatomical structure), Locate objects in satellite image, Face Recognition, Finger print Recognition, etc. Choice of a segmentation method over another and the level of segmentation are decided by the particular type of image and characteristics of the problem being considered.

The main objective of using a clustering algorithm is to combine data into small groups such that the data in each group possess similar characteristics though the data clusters are distinct from each other. It is an unsupervised clustering technique which has a strong inclination towards the local minima while finding an optimal solution. Therefore, the distribution of initial cluster centers drastically decides the process of clustering. Therefore, the determination of the good initial parameters is a challenging problem and hence the clustering algorithms necessitate more number of experimentation to decide the input parameters.

II. IMAGE SEGMENTATION

The process of partitioning a digital image into multiple groups or segments. The main goal of segmentation is to simplify the image or change the representation of an image into more easier to analyze and must be meaningful. Image segmentation is used to locate lines, curves etc in images. Image segmentation is the process of giving a label to every pixel in an image. Image segmentation is the first step in image analysis and pattern recognition. It is a critical and essential component of image analysis system, is one of the most difficult tasks in image processing, and determines the quality of the final result of analysis. Image segmentation is the process of dividing an image into different regions such that each region is homogeneous [2]. Image segmentation methods can be categorized as below

- Region Based Methods
- Edge Based Methods
- Hybrid Techniques

III. PARTICLE SWARM OPTIMIZATION ALGORITHM (PSO)

Particle swarm optimizers (PSO) are population-based optimization algorithms modeled after the simulation of social behavior of bird flocks [Kennedy, Eberhart,1995]. In a PSO system, a swarm of individuals (called particles) fly through the search space. Each particle represents a candidate solution to the optimization problem. The position of a particle is influenced by the best position visited by itself (i.e. its own experience) and the position of the best particle in its neighborhood (i.e. the experience of neighboring particles).

The performance of each particle (i.e. how close the particle is from the global optimum) is measured using a fitness function that varies depending on the optimization problem.

Each particle in the swarm is represented by the following characteristics:

xi : The current position of the particle;

vi : The current velocity of the particle;

yi : The personal best position of the particle.

For each iteration of a PSO algorithm, the velocity vi update step is specified for each dimension j = 1.. Nd, where

Nd is the dimension of the problem. Hence, vij represents the jth element of the velocity vector of the ith particle. Thus the velocity of particle i is updated as using the following equation:

$$v_{i,j}(t+1) = wv_{i,j}(t) + c_1 r_{1,j}(t)\left(y_{i,j}(t) - x_{i,j}(t)\right) + c_2 r_{2,j}(t)(\hat{y}_j(t) - x_{i,j}(t)) \qquad (1)$$

Where w is the inertia weight C1 and C2 are the acceleration constants and r1j and r2j. The position of particle i, xi, is then updated using the following equation:

$$x_i(t+1) = x_i(t) + v_i(t+1) \qquad (2)$$

The algorithm can be summarized as follow

1) Initialize: Initialize parameters and population with random position and velocities.

2) Evaluation: Evaluate the fitness value (the desired objective function) for each particle.

3) Find the gbest: If the fitness value of particle i is better than its best fitness value (pbest) in history, then set current fitness value as the new pbest to particle i.

4) Find the gbest: If any pbest is updated and it is better than the current gbest, then set gbest to the current value.

5) Update position: update velocity for each particle by applying equation (1) and (2).

In this project the PSO algorithm are used to find the cluster centers in the ab color space. The each cluster is considered as the one of segment (color) of image.

IV. SIMULATION AND RESULTS

The block diagram shown in the figure 1 is showing the simulation scheme. In the process of the segmentation, first the RGB image converted in the Lab space. This process reduces the one of the dimension which represents the color information. The ab space is representing the color component of image. The ab component then converted in the array, which reduce the two dimensional geometric information in one dimension. This ab space information is then clustered using PSO algorithm. The each cluster are processed to find the color segment of image.

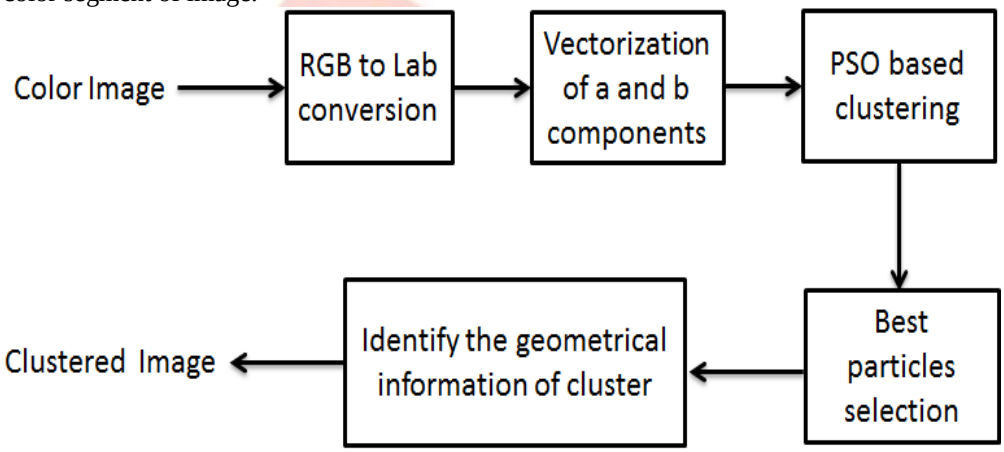

Fig.1 Simulation scheme for image segmentation based on color

The simulation of PSO algorithms on several images has been applied. The typical results for one of the color image is show in below:

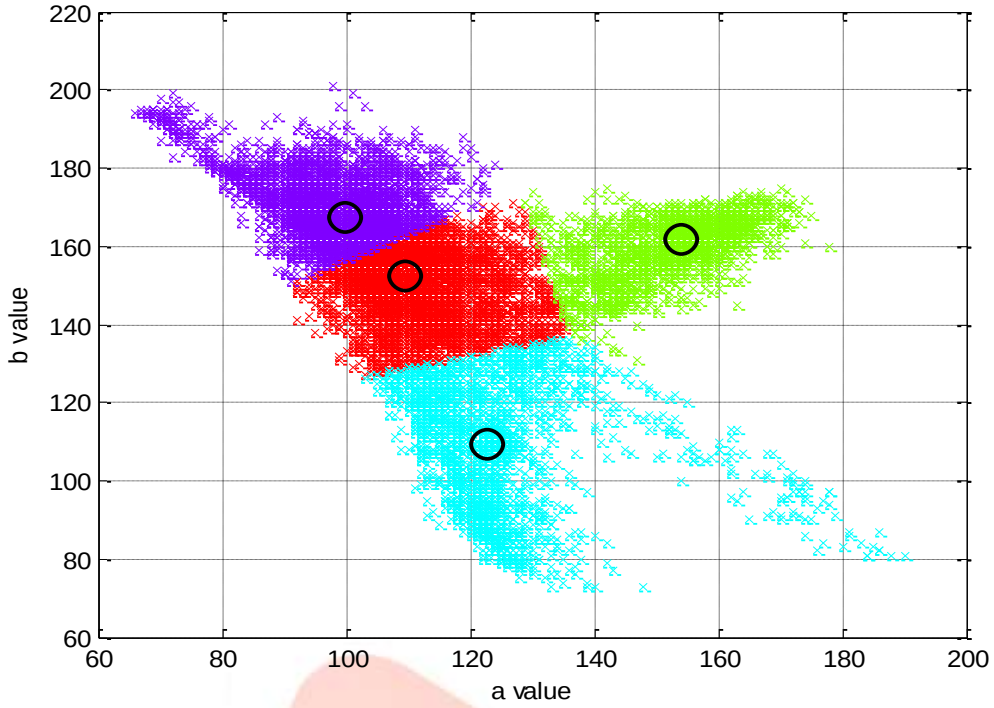

Fig. 2 Typical; graph for no. of clusters in ab space

With the above diagram it is clear that the distances between the colors of each cluster element are minimized and the cluster centers are well placed by PSO in the ab space. The objective function of PSO algorithm is to minimize the sum of distances between cluster center and its members for each cluster. The convergence curve with the iteration for PSO is shown in figure 5.

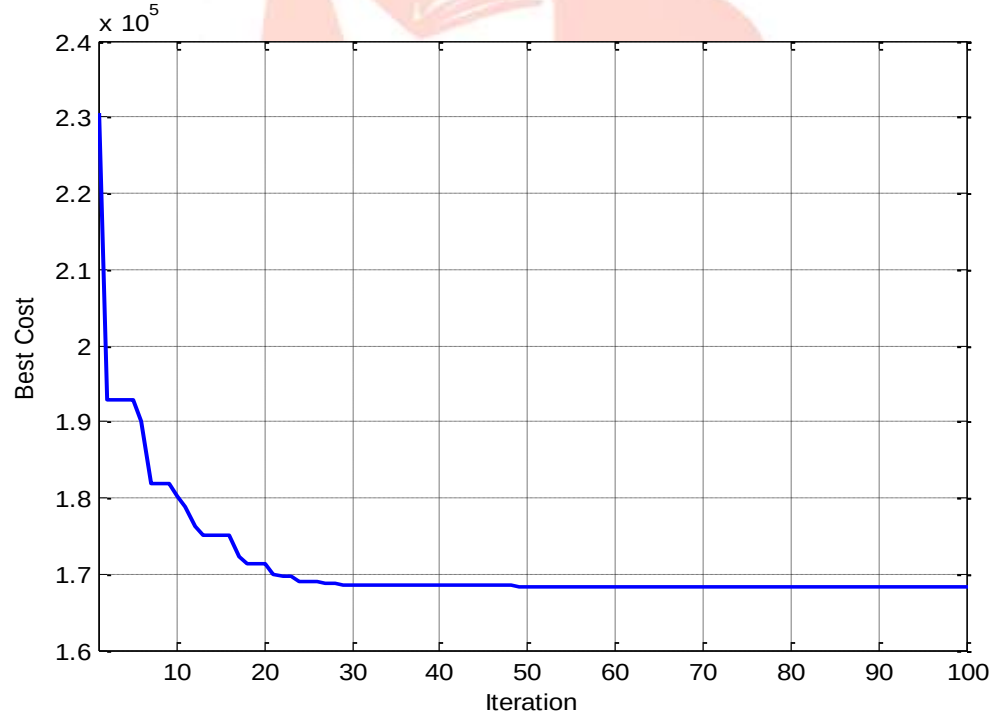

Fig 3 Performance of PSO for Best Cost with iteration

Total 48nos. of iteration are used to converse the PSO algorithm to identify the cluster center. Typical results of the segmentation are shown in the figure 4 and figure 5.

Fig. 4 Original Color Image

Fig. 5 Color Image segmentation

V. CONCLUSION

The image segmentation with PSO based clustering technique was developed and tested successfully in CIELAB color space. The dimension reduction for the color image segmentation provides the more visualization and simplifies the segmentation process. From the result section it is clearly observed that the segmented parts are indicating the different colors in images. The algorithm may further upgrade for the automatic determine the no. of cluster in the image. The texture based segmentation may be hybrid with color image segmentation. PSO method itself may be upgraded to the new evolutionary algorithm for fast conversion.

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