Thresholding and Swarm Intelligence Technique for Image Segmentation: An Overview

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Abstract- The present technique used for the image processing is image segmentation. The gain of the information is more and accurate in the image segmentation process. There are several techniques and methods for the segmentation process of the image. For the practical use the technique based on the thresholding is one of the most simple and important technique. The thresholding technique of segmentation of the image based on the 2-D histogram is useful for the practical work. The grey value of the pixels of the image and average of the grey value of the pixels is used for the segments of the image. The nature of the image is digital in nature for the segmentation of the image.

In this paper we will study the use of algorithm known swarm intelligence for the segmentation of the image. The process of the segmentation of the image is fast by using this algorithm. This algorithm is useful for performing segmentation of the image in the real images. Several tests and implementations have been done using this algorithm on the real image. The results from different test that we have received have showed that this algorithm is applicable for the real time applications and requires less computational time.

Keywords- 2-D histogram, swarm intelligence, real time application, grey level

I. Introduction-

The visual presentation of any kind of the information in the form of the picture is called image. The image that is composed of picture element such as pixels with specific grey level using spatial coordinates x, y and z is digital image. The process of obtaining information from a digital image by dividing image into small segments is known as image segmentation. The process of segmentation of the image is used for the processing of the image. The segmentation of the image takes place on the basics of the pixels of the image and their grey level.

The process of the segmentation of the image converts raw image i.e. input into segments over a region that is non-overlapping in nature so that this region similar in the nature and combination of two side by side regions is non-similar in the nature. This is one of the most important and tough low-level way of analyzing any task and requires more attention.

Various techniques and method have been introduced for performing segmentation of the image such as clustering based segmentation of the image, histogram based technique of the segmentation of the image, edge detection based method of the segmentation of the image etc[1].

There is difference between grey level of the pixels of the object and the grey level of the pixel related to the background in various application of the processing of the image. The one of the simplest and most effective technique for segmentation of the image is thresholding. Since the threshold technique of the segmentation of the image is known for its simplicity so it can be highly useful in the area where real time processing of the image is required.

In the threshold based segmentation of the image we require a threshold value for performing segmentation of the image especially when there is selection of the multiple levels for segmentation. Some other methods that are used are maximum entropy method, Otsu's method and k-means clustering.

There is use of histogram for performing threshold selection process. In histogram we represents object and background as valley that are deep and sharp between two peeks respectively. For the selection of the proper threshold, the grey level present at the bottom of the valley is selected. For testing the performance of the thresholding method, the shape of the histogram is studied for the image that is needed to be segmented. This testing is required for real image if there are no different shapes of the valleys formed or the shape of the valley is flat. The only way to remove this disadvantage is to get spatial connection between pixel and grey level of the pixel. The method named as 2-D entropy threshold was given Abutaleb. This method is based on the 2-D histogram.

The algorithm that is decentralized and self-organized system is called swarm intelligence. In present time the use of swarm intelligence has increased a lot in various applications and has improved performance. In this paper we will study about algorithm known as swarm intelligences and 2-D fisher criterion thresholding method for segmentation of the image.

II. Objective-

The main objective of this paper is to study about two dimensional fisher algorithms for segmentation of the image and swarm intelligence for the segmentation of the image.

Two dimensional fisher algorithms for segmentation of the image-

The method of classification that is used for projecting high-dimensional data on a line and performing the process of the classification in the one-dimensional space is called fisher's linear discriminant. The main purpose of the fisher's linear discriminant is to find out a linear transform for reducing dimension of n-dimension of the statistical model that consist of k classes to d(d _<n) dimension.

In the process of the transform, the information of the discrimination is stored on the lower dimensional model. It also reduces the distance between the classes that are already separated from each other. This may results to the high level of the overlapping as shown in the figure 1.

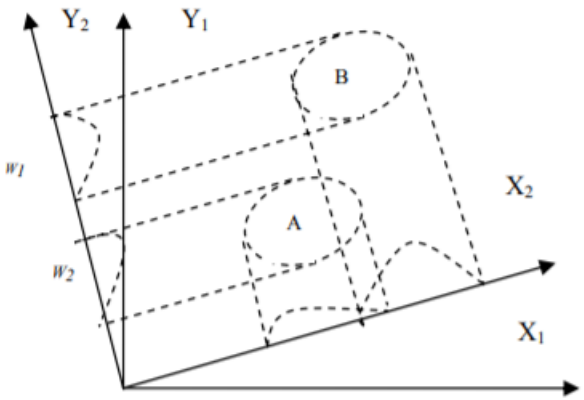

Fig. 1- 2-D feature vector[12]

The class information is classified as two types of the scatter matrices. This are-

- Between-class scatter
- Within-class scatter

The formula that represents fisher criterion is-

$$J(w) = \frac{|m_1 - m_2|^2}{s_1^2 + s_2^2}$$

"m" shows mean**"s^2"** shows variance.

The transformation of the "L" is obtained by maximizing the above formula. This maximization shows that between classes scatter is maximum in nature, within class scatter is minimum in nature and discrimination is optimal in nature.

Swarm intelligence approach for segmentation of the image-

The use of 2-D Fisher image segmentation is used as problem optimizing function. 2-D fisher criterion function is known to maximization process for optimization problem. To optimize the principle of the two dimensional Fisher criterion we use swarm intelligence algorithm. There are two approachesfor swarm intelligence. That are-

- Artificial bee colony approach
- Particle swarm intelligence approach

Artificial bee colony algorithm-

A type of optimization algorithm that is based on quick-witted foraging nature of honey bee swarm is known as artificial bee colony algorithm. This algorithm is proposed by karaboga in the year 2005. This algorithm is optimization algorithm that is based on the intelligence as found in the honey bee swarm. This algorithm was firstly proposed in the year 2005 by D. Karaboga. Many researchers including Karaboga have been studying about this algorithm and various applications of the algorithm and related real life problems.

There is a presence of the three groups of the bee in the artificial bee colony algorithm. They are-

- Employed bees
- Onlookers
- scouts

Assumption is made that for each source of food there is presence of the single artificial employed bee. By this we mean that there is equal number of the source for the food as the number of the employed bees within the colony in the hive. The only employed bees travel to their food source and then return back to their own hive and keep on dancing around that area. The source of the food that gets unoccupied that employed bee converts into scouts and goes for the search of new source of the food. The work of onlookers is to see the dance of the employed bees and take their source of the food according to the pattern of dance of the employed bees. In figure given below we are showing the pseudo code of the artificial bee colony algorithm.

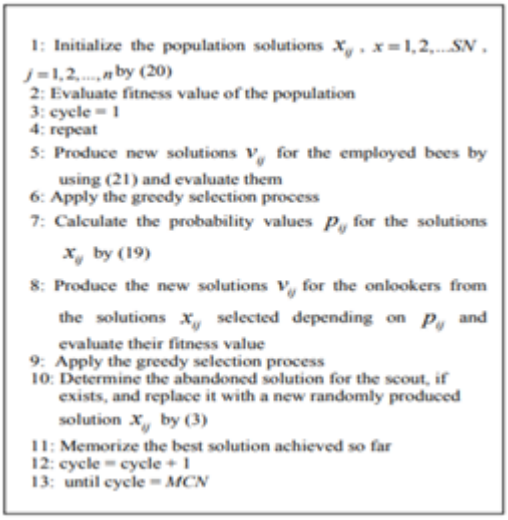

Fig. 2- Pseudo code for artificial bee colony algorithm

Particle swarm optimization approach-

The technique whose computation is evolutionary in nature is particle swarm optimization algorithm. This algorithm is developed by Kennedy Eberhart in the year 1995. This algorithm is trained by organism's social behavior that is many birds flying together in the sky, many fishes moving together in the same direction etc. There are many similarity between particle swarm optimization approach (PSO) and genetic algorithm (GA) on the basis of evolutionary computation techniques. The process for initialization of the system can be done by populating various solutions and by the update of the generation we can get optima solution. There is no evolutionary operator in the particle swarm optimization approach just like in genetic algorithm. These evolutionary operators are crossover and mutation. Particle in the particle swarm optimization approach is known as potential solution. These particles move through a space by using present optimum particle. The advantage of the particle swarm optimization approach in comparison to the genetic algorithm is that it can be implemented easily. The parameter that are used for the adjustment in particle swarm optimization approach are implemented properly and are applied in various area successfully. These areas are-

- Function optimization
- Artificial neutral network training
- Fuzzy system control

And those area where genetic algorithm is applicable.

To understand particle swarm optimization approach let's consider an example. In the search of food a group of birds are flying randomly. The area where birds are searching for food has single piece of food. All birds in the group have no idea where the food is. The birds have idea of how far away the food is present. With what technique will birds will reach to the food? The answer is to keep on following the bird that is closest to the food.

The process of solving problems in the particle swarm optimization approach is by learning through its scenario. In the above given example bird is solution in the given search space and they are known as particle. These particle have fitness value that is calculated by the use of the fitness function. The present optimum particle is used for flying through problem space.

In the given figure below represents complete flow chart of particle swarm optimization approach.

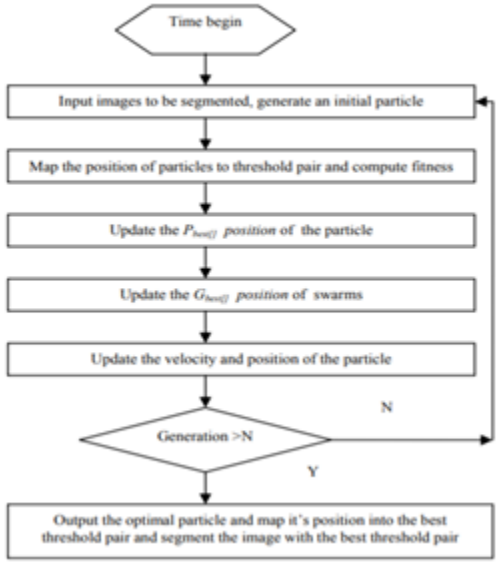

Fig.3- Flow chart for Particle swarm optimization approach[12]

III. Related works-

In [2] the author has represented Renyi's entropy for the segmentation of the image. The author has used global thresholding method for the segmentation of the image.

In [3] the author has showed that for infrared image the approach used for the thresholding is based on the maximization of entropy of the 2-D gray scale histogram.

In [4] the author has shown the use of Fisher linear discriminant for optimum projection of 2-D histogram. The image that is based on the local average histogram, gives better segmentation as compared to others that uses simple criteria based on 2-D histogram.

In [5] the author has studied about how approach of fuzzy entropy performs when it is use for segmentation process of infrared objects.

In [6] the author has given new algorithm known as optimization algorithm. This algorithm is based on intelligence in the behavior of honey bee. This algorithm is flexible and simple in comparison to the present swarm algorithm.

In [7] the author has used artificial bee colony algorithm for optimization of multi variable function and outcome is given by the use of artificial bee colony algorithm, genetic algorithm

In [8] the author has worked on new technique in artificial bee colony algorithm that is used for designing IIR filter that is digital in nature.

In [9] the author has explained a modified way of the artificial bee colony algorithm for solving the problem and this modified technique is tested over four different engineering standards.

In [10] the author has studied about how to optimize non-linear function using technique known as particle swarm method. The use of benchmark testing and its application has been studied.

In [11] the author has explained that how particles of swarm intelligence can be optimized in the field of cooperate.

IV. Conclusion-

One of the most challenging parts of the image segmentation is selection of the tough and prime threshold and separating object from it or separating object from the background. The one of the best method to perform segmentation of the image is two dimensional histogram based thresholding such as two dimensional fisher methods. This method of segmentation of the image has only disadvantage that it requires maximum computation time in comparison to others. In this paper we have discussed about performing segmentation of the object by two dimensional fisher segmentation method of the image.

Another method that we discussed in this paper is swarm intelligence approach of image segmentation which is categorized as particle swarm approach and artificial bee colony algorithm that helped in getting optimum threshold for two dimensional histogram method of segmentation of the image. By the study we have come through a conclusion that method proposed such as artificial bee colony approach and particle swarm optimization based on two dimensional fisher algorithms are more efficient search performed as compared to search method that exhaustive in nature. These algorithms have given best performance and are useful in the real time analysis process and application of the image. .

V. References-

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