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Face Recognition System with Genetic Algorithm and ANT Colony Optimization

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***Abstract*—In this paper, a novel face recognition system to detects(finds) faces in images and video tracks faces ,recognizes faces from galleries of known people using Genetic and Ant colony Optimization algorithm is proposed. This system is caped with three steps. Initially pre-processing methods are applied on the input image. Consequently face features are extracted from the processed image by ANT Colony Optimization (ACO) and finally recognition is done by Genetic Algorithm (GA. The proposed method is tested on a number of test images**

***Index Terms*—Face Detection, Genetic Algorithm, Ant Colony Optimization Algorithm**

I. INTRODUCTION

Face recognition is the process of automatically determining whether two faces are the same person. A number of factors make this a challenging problem for computers. Faces in images and video can be captured at various resolutions, quality, and lighting conditions. Different cameras have different imaging properties. Moreover, people's facial expressions as well as their pose with respect to the camera can vary widely, and facial characteristics can change dramatically as people age over time. As such, our face recognizers, like our detectors, have been trained using novel statistical learning methods, to deal with these diverse factors and provide accurate results on real-world data. By design, our face recognition technology performs accurately on real-world, uncontrolled data, Appearance variations due to weight loss, facial hair, hair style, hats and glasses,Uncontrolled pose and facial expressions,Uncontrolled lighting, both indoor and outdoor,Low-resolution / low-quality face imagery. Face recognition system is trained to operate on low-resolution faces. In our staged approach, the recognizers analyze facial features at three separate resolution levels – namely, 12, 20 and 25 pixels between the eye centers. This approach has led to unparalleled accuracy on challenging low-resolution media.

The first step in face recognition is the acquisition of faces in visual media. Face acquisition for the purposes of recognition requires not only face detection, but precise alignment prior to matching faces. We perform this alignment automatically through pose estimation and landmark localization.

II. HEAD POSE ESTIMATION

Our face detection technology not only locates faces, but it also estimates the three-dimensional head pose (orientation of the head with respect to the camera). Our head pose estimation technology allows end-users to select between coarse and fine-pose estimation. Coarse-pose detection is more computationally efficient, while fine-pose detection is more accurate in orientation. Since pose estimation is an inherent part of face detection, it inherits all its features, including the capability to estimate the pose of low-resolution faces for uncontrolled real-world imagery. As part of our alignment algorithm for face recognition, we automatically detect anatomically defined points on the face across all poses, from frontal to profile faces. These include specific landmarks such as the center of the eye cavities, and the bridge, tip and base of the nose. While face alignment is our principal motivation behind developing accurate and precise landmark detectors, localization of certain landmarks, such as the eyes, can be an important component of other applications, such as iris-based recognition, as well. Our landmark detectors are pose-specific. That is, we detect different sets of landmarks based on the head pose of the detected face. For frontal and semi-profile faces, we detect one set of landmarks, while for full-profile faces, we detect a second set of landmarks, since different points on the face are visible in each case

A. *Face Image Acquisition [1][2]*

To collect the face images, a scanner has been used. After scanning, the image can be saved into various formats such as Bitmap, JPEG, GIF and TIFF. This FRS can process face images of any format.

B. *Filtering and Clipping [1][2]*

The input face of the system may contain noise and garbage data that must be removed. Filter has been used for fixing these problems. For this purpose median filtering technique has been used. After filtering, the image is clipped to obtain the necessary data that is required for removing the unnecessary background that surrounded the image. This is done by detecting the window co-ordinates (Xmin, Ymin) and (Xmax, Ymax).

C. *Edge detection [7]*

Several methods of edge detection exits in practical. The procedure for determining edges of an image is similar everywhere but only difference is the use of masks. Different types of masks can be applied such as Sobel, Prewitt, Kirsch, quick mask to obtain the edge of a face image. The performance of different masks has a negligible discrepancy. But here quick mask has been used as this is smaller than any others. It is also applied in only one direction for an image; on the other hand others are applied in eight direction of an image. So, the quick mask is eight times faster than other masks. The detected edge of a face after applying quick mask is shown in fig.5.

D. Features Extraction[7]

To extract features of a face at first the image is converted into a binary. From this binary image the centroid (X, Y) of the face image is calculated using equation 1 and 2.

Fig.1. Edges of Face Images

$$X = \frac{\sum mx}{\sum m} \qquad (1)$$

$$Y = \frac{\sum my}{\sum m} \qquad (2)$$

*Where x, y is the co-ordinate values and m=f(x,y)=0 or 1.*Then from the centroid, only face has been cropped and converted into the gray level and the features have been collected.

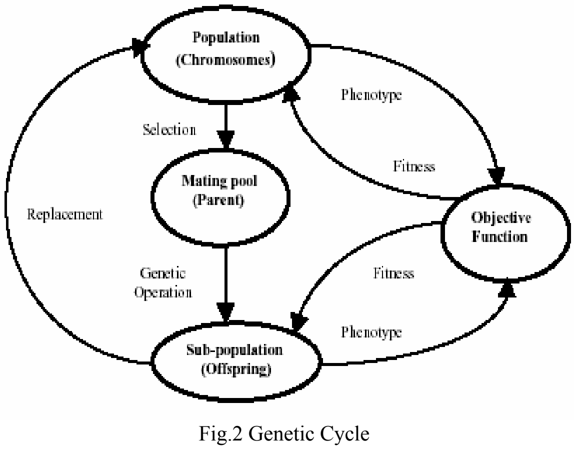

Fig.2 Genetic Cycle

III. PROPOSED ACO GENETIC ALGORITHM (ACOG)[5]

A combinatorial optimization problem is a problem defined over a set C = c1....cn of basic components. A subset S of components represents a solution of the problem; $F \subseteq 2^c$ is the subset of feasible solutions, thus a solution S is feasible if and only if $S \in F$. A cost function z is defined over the solution domain, $z : 2^C \dashrightarrow R$, the objective being to find a minimum cost feasible solution S*, i.e., to find S*: $S^* \in F$ and $z(S^*) \leq z(S)$, $\forall S \in F$. They move by applying a stochastic local decision policy based on two parameters, called trails and attractiveness.

By moving, each ant incrementally constructs a solution to the problem. The ACO system contains two rules:

1. Local pheromone update rule, which applied whilst constructing solutions. 2. Global pheromone updating rule, which applied after all ants construct a solution. Furthermore, an ACO algorithm includes two more mechanisms: trail evaporation and, optionally, daemon actions. Trail evaporation decreases all trail values over time, in order to avoid unlimited accumulation of trails over some component. Daemon actions can be used to implement centralized actions which cannot be performed by single ants, such as the invocation of a local optimization procedure, or the update of global information to be used to decide whether to bias the search process from a non-local perspective. At each step, each ant computes a set of feasible expansions to its current state, and moves to one of these in probability. The probability distribution is specified as follows. For ant k, the probability of moving from state t to state n depends on the combination of two values: the attractiveness of the move, as computed by some heuristic indicating the priori desirability of that move; the trail level of the move, indicating how proficient it has been in the past to make that particular move: it represents therefore an a posteriori indication of the desirability of that move.

IV. ACOG ALGORITHM [5]

An ACOG is differing from previous algorithm. It uses genetic programming to enhance performance. It consists of two main sections: initialization and a main loop, where Genetic Programming is used in the second sections. The main loop runs for a user defined number of iterations. These are described below:

A. Initialization:

Set initial parameters that are system: variable, states, function, input, output, input trajectory, output trajectory. Set initial pheromone trails value. Each ant is individually placed on initial state with empty memory.

B. While termination conditions not meet do Construct Ant Solution:

Each ant constructs a path by successively applying the transition function the probability of moving from state to state depend on as the attractiveness of the move, and the trail level of the move.

Apply Local Search

Best Tour check: If there is an improvement, update it.

Update Trails:

A. Evaporate a fixed proportion of the pheromone on each road.

B. For each ant perform the “ant-cycle” pheromone update.

Reinforce the best tour with a set number of “elitist ants” performing the “ant-cycle”

TABLE 1 PARAMETER SETTINGS

Chromosome Length	32 bits
Population Size	150
Number of Generation	300
Cross over probability	0.7
Mutation Probability	0.01

Initial Population: Generate randomly a new population of chromosomes of size N: x1, x2,…..$x_{n.}$.Assign the cross over probability P_C and the mutation Probability P_M.

Evaluate the Fitness function for each chromosome in the population.

Fitness Function: To determine where a selected region is a face or not a function need to assign a degree of fitness to each chromosome in every generation. The fitness of a chromosome is defined as the function of the difference between the intensity value of the input image and that of the template image measured for the expected location of the chromosome. That is for each chromosome n, fitness function is defined as

$$f(n) = 1 - \frac{\sum_{(x,y)\in W} \left| f(x,y) - f_{n,t}(x,y) \right|}{B_{\max} \times xSize \times ySize}$$

where B_{max} is the maximum brightness of the image, *xSize* and *ySize* are the number of pixels in the horizontal and vertical directions of the image, *W* is the window, f *and* $f_{n,t}$ are the intensity values of the original image and the template image when it is justified for the *n*-th position of the chromosome, respectively.

Selection: Select a pair of chromosomes for mating use the roulette wheel selection procedure, where each chromosome is given a slice of a circular roulette wheel. The area of the slice within the wheel is equal to the chromosome fitness ration obviously the highly fit chromosomes occupy the largest areas, where the chromosomes with least fit have much smaller segments in the wheel. To select chromosome for mating a random number is generated in the interval [0.100], and the chromosome whose segment spans the random number is selected.

Cross over: Produce two offspring from two parent chromosomes. Cross over operator chooses a crossover point where two parent chromosomes break and then exchanges the chromosomes parts after that point. As a result two offspring are generated by combining the partial features of two chromosomes. If a pair of chromosomes does not takes place, and the offspring are created as exact copies of each point. This research employs single point cross over, two point cross over and uniform cross over operators. The crossover points are selected randomly within the chromosome for exchanging the contents.

Mutation: Apply the conventional mutation operation to the population with a mutation rate $P_{M.}$ For each chromosome generate a random value between [0,1].If the random value is less than P M choose a bit at a random location to flip its value from 0 to 1 or 1 to 0. The parameter setting approach is shown in Table 1.

By applying the above operation, based on pheromone trails. The operations are applied to individual(s) selected from the population with a probability based on fitness.

End While

V. Experimental Results

Table I Results for FRS

Therefore the efficiency of the Face Recognition System by using Genetic and Ant colony Optimization Algorithm is Best than other methods.

Face Recogonization system is supported with Platforms Microsoft Windows® 2000, XP, Vista, 7 (32 and 64 bit)Mac OS X (Version 10.5 or later, 64 bit)Linux (32 and 64 bit)

Intel Pentium 4-class, 1 GB RAM

No. of Face Image	Successfully Recognized Face Image	Unrecognized Face Image	Efficiency (%)
5	4	2	80
13	12	1	92.3
20	19	1	95
22	19	3	86.3
25	24	1	96
30	28	2	93.3

VI. Conclusion

In this paper, a prototype of Face Recognition System using the soft computing techniques like Genetic algorithm and Ant colony optimization algorithm is discussed the experimental results shows that this method is more robust suitable for low resolution, variable lighting and different facial expressions applied in real time video processing, single and multi threaded processing. The competence can be greater than before by using better face scanner, best technique of scaling and well-organized technique of edge detection and feature extraction of the face image.

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