



An Approach to Detect and Recognize Face using Swarm Intelligence and Gabor Filter

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Abstract— Face recognition is an obscure and enchants software achievement. This is Non-Intrusive technique. This paper focuses on the method of feature extraction and feature selection to boost up the efficiency of face recognition systems. Here we are using minimal selected features with encouraging results in face recognition. This paper revolves around feature extraction, feature selection and recognition. Here feature extraction done using Gabor Wavelet. These extracted features are used for feature selection by using Artificial Bee Colony Optimization using with the parameters such as fitness test and correlation. At last face is recognized using another nature based intelligence technique called Ant Colony Optimization by calculating distance between selected features. Gabor Wavelet and nature based intelligence techniques shows to be providing encouraging results when used in fusion.

Keywords— Face Recognition, Feature Extraction, Feature Selection, Swarm Intelligence, Gabor Wavelet, Artificial Bee Colony Optimization (ABC), Ant colony optimization (ACO).

I. INTRODUCTION

Face is the unique selfhood and mode of distinctiveness of individual from other individuals. Human have by birth the ability to recognize the person. When the child is small, there is no need to make him teach how to recognize the person. But if we talk about the computer or machine we have to make him teach how-to recognize a person. Then concept of face recognition changes for computer. Different algorithms and technology is being used to teach those [9] [4]. In this research, for face recognition fusion of three techniques is being used. For feature extraction, Gabor filter is being used. Well, it provide us with output which is fed in next step i.e. feature selection. In this step we will select the features using Artificial Bee Colony Optimization. Then we provide obtained output to Ant Colony Optimization for Face recognition, which will use concept of calculating distance between selected features.

A. Face Recognition

Face recognition is appealing solicitude in all areas i.e. engineering, management, psychology, neuroscience and many more. Face recognition is a technique which doesn't require user cooperation [12]. Now days, face recognition system is used for many purposes such as face identification, access control, security, surveillance, smart card and law enforcement [14]. Face recognition system is made up of following stages face detection, feature extraction, feature selection and face recognition [18]. In this research we will focus on Feature extraction (which is mainly defined as methodology of extracting relevant information from image), Feature Selection, (which is used to select the subset of extracted features for classification) and finally face recognition (correctly recognize face on minimal selected features.) [14].



Figure 1: Process for Face Recognition.

B. Feature Extraction

Feature extraction means extracting features from the image. It is the core sub process of the face recognition process. It helps in extracting relevant information from the image, which will help us in face recognition, with good and efficient results. In case of face recognition features can be chin, nose, lips, eyes and shape of the face. Now days, there are many feature extraction methods such as Discrete Fourier Transformation, Discrete cosine Transformation, Eigenvectors-PCA, Discrete wavelet Transformation, and Gabor wavelet. But here we are going to work on Gabor Wavelet [12] [14].

C. Feature Selection

Feature selection is the process, which is used to select the best features out of the extracted features on the basis of which we can do the classification [15]. The idea behind the concept of feature selection is to minimize the dimensionality and also complexity of the face recognition process [16]. There are many methods for doing the feature selection such as exhaustive search (i.e. evaluate all possible subset of the features), best individual features (i.e. evaluate and select features individually), sequentially forward selection (that means starts from the best growing features and many more).

II. INTRODUCTION TO TECHNIQUES USED

A. Gabor Wavelet:

Gabor-filter is being used in many computer vision processes such as the texture segmentation, face recognition, iris recognition and many more. Gabor filter have many beneficial properties for feature extraction. Feature extraction techniques are used for extracting fixed and distinguished feature from the facial images regardless of the environmental conditions. This is a harmonic function, which is being modulated by Gaussian distribution. Gabor filter is used in texture analysis in image processing. Well the frequency and orientation representation is almost same as that of human vision. Gabor filter is a linear filter, which is defined as harmonic function multiplied by Gaussian function [13].

B. Swarm Intelligence

Swarm intelligence is nature-based intelligence. Swarm intelligence is used for solving optimization problems [1]. It is part of the artificial intelligence. Swarm intelligence works over the concept of autonomous agent. Swarm intelligence has been used in many research areas even in robotics [17].

C. Artificial Bee Colony

Well, artificial bee colony is a swarm intelligence algorithm, which is inspired by the collective behaviour of the honeybees. It is a kind of multi agent system, which solves difficult problems. This algorithm mainly contains three types of bees in the colony. Employed bees are the bees, which search for nectar and leave the hive for searching. When they find some nectar they come back and share their information with the onlooker bees. For exchange of information they dance in the hive. The information contains details about the intensity, duration and direction about the food source. Then the onlooker bee while referring the information provided decide to which source they have to follow. Then they move to the food source collect nectar and come back to hive. Scouts on the other hand investigate new areas with possible sources [3].

D. Ant Colony Optimization

Well ant colony is said to be the probabilistic technique, which is used for solving the computational problems. 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 [6].

III. AN APPROACH OF THIS METHOD

A. Gabor Filter-Feature Extraction

Gabor filter is applied on the image to extract the features like we can find out the points of the feature. In this we apply Gabor filter with different orientation and angles. Then we will find out maximum intensity points in all images [7]. Then these feature points are provided as input to the next stage.

B. Artificial Bee colony-Feature Selection

Following are assumptions and steps to be performed [5] [2].

Table 1: Assumptions of ABC

Assumptions	
❖	Bees= pixels of image.
❖	Food source= Feature extracted.
❖	Number of employed bees = number of food source.
❖	Number of onlooker = ol and Number of scouts =1.

Steps:

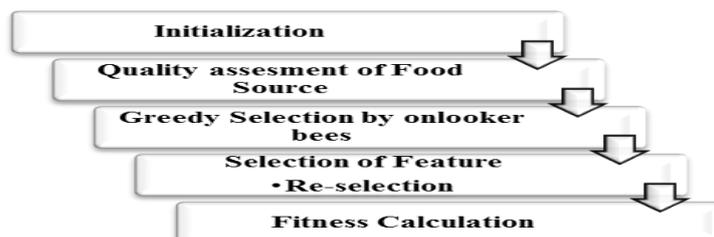


Figure 2: Steps for ABC

Step 1: This is the Initialization Step i.e. it initializes the population of the solution/feature/food source. In this step we will place employed bee on each food source.

Step 2: This step includes the quality assessment of food source. In this we will evaluate the food source using normalized correlation coefficient $c(x, y)$. Correlation is termed as template matching.

$$c(x, y) = \frac{\sum_s \sum_t [f(s, t) - \bar{f}(s, t)] [w(x+s, y+t) - \bar{w}]}{(\sum_s \sum_t [f(s, t) - \bar{f}(s, t)]^2 \sum_s \sum_t [w(x+s, y+t) - \bar{w}]^2)^{1/2}}$$

Where

$c(x, y)$ = Correlation coefficient range

w = Filter mask of size $m \times n$ (template)

\bar{w} = Average value of mask

f = Image in database

\bar{f} = Average value of f in region co-incident with w

Step 3: In this step onlookers do the greedy selection. In this step for all food sources we calculate probability of values.

$$p_i = \frac{c_i}{\sum_{n=1}^N c_n}$$

Where

$i = \{1, 2, 3, \dots, N\}$

Where N = total number of food source.

p_i = Probability of i th food source

c_n = Correlation Value

Then the onlooker bee will select the maximum p_i and will follow the employed bee to the selected food source.

Note: - Step 2 will repeated for all onlooker bees and will calculate probability for each onlooker bee.

Step 4: In this step we do selection of features. Now we have to calculate average of correlation value obtained by each onlooker bee for a particular food source.

$$\frac{\sum_{i=1}^{ol} c_i}{ol} \geq 0$$

Where

ol = number of looker.

c = Correlation Value.

Note: -If the average of correlation value is equal to or greater than zero we will select the feature and will go to step 6 else we will go to step 5.

Step 5: In this step we do the reselection of features. In this we will produce the candidate food position from the old one in memory, which may have been abandoned while feature extraction. We use following formula for reselecting features.

$$v_{ij} = x_{ij} + \varphi_{ij}(x_{ij} - x_{kj})$$

Where

$k = \{1, 2, 3, \dots, N\}$

Where N = total number of food source.

$j = \{1, 2, 3, \dots, D\}$

x_{ij} = Random pixel value

x_{kj} = Random pixel value

φ_{ij} = Random number between $[-1, 1]$

1) Note: - when all the candidate position v_{ij} is produced and is evaluated by bee, and then its performance is compared with that old one. If the new food source has equal or better nectar value then new one in the memory replaces this value. Otherwise old value will remain in the memory.

Step 6: In this step we calculate fitness value. If the fitness value is less than or is equal to 1, then we will continue face recognition otherwise no image found and we will exit.

$$v_{ij} = \begin{cases} \frac{1}{1+f}, & f \geq 0.8 \\ 1 + abs(f), & f < 0.8 \end{cases}$$

Where

$$f = \frac{\sum_{i=1}^{N_s} c_i}{N_s}$$

Where N_s = number of selected features

C. Ant colony optimization

These are the following steps and assumptions to be followed in face recognition using ant colony optimization.

Table 2: Assumption for ACO

Assumptions	
➤	Nodes/ food source= represent selected features.
➤	Ants = pixels of image (replaced)

Steps:

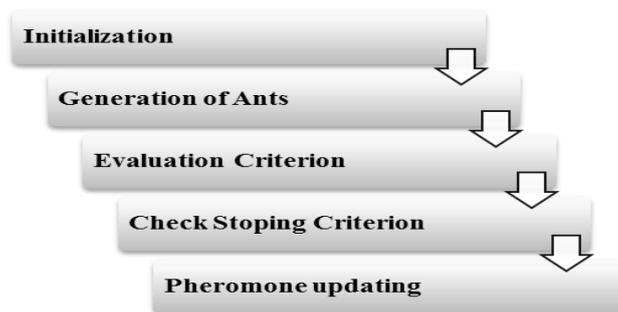


Figure 3: Steps for ACO

Step 1: This is the initialization step in which we will determine, the population of ants which would be equal to the number of features. We will set the intensity of pheromone trail associated with any of the path among the features. That means that we will read the distance among features in the given image and determine the threshold value. In this we will also define the maximum number of iterations is allowed i.e. number of nodes and paths can be traversed.

Step 2: This step contains generation of ant. In this we will place one ant on each selected feature. We can assign any ant to feature. This ant should visit all features and build the solution completely.

Step 3: 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: 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: In this step we do the process of pheromone updating i.e. pheromone intensity for the features, which are selected in step3, is updated. By doing this we will mark the path as verified and node as visited.

IV. CONCLUSION

Well, we have proposed method for recognition using Gabor wavelet and swarm intelligence. In this research we are doing feature extraction by using Gabor filter and feature selection using Artificial Bee colony optimization and recognition is done using Ant colony optimization. This is an effective method for face recognition as we have focused on feature selection and feature extraction, thus providing encouraging results.

V. FUTURE SCOPE

In future we can work on same technique but using side face recognition, twin detection and 3D recognition. We can enhance this technique by using different feature extraction and selection methods. We can also fuse the face recognition concept with figure print recognition or palm recognition, based on same concept. We can also merge this concept with neural network.

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