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Enhanced Face Matching Technique Based Gabor Filter and PSO

Simrandeep Singh
Chandigarh University
Chandigarh, India

Ishdeep Singla
Chandigarh University
Chandigarh, India

Abstract- In this paper a new method is developed for face matching/face recognition which is based on Gobar filter and PSO. Gobar filter is a very good tool for feature extraction among others. Gobar filter has one property that is can facial features automatically which makes it more powerful. In this paper, PSO (Particle Swarm Optimization) is also used for face recognition. Feature selection is a major problem in matching learning which causes in reduction of number of features i.e. remove irrelevant and noisy data.PSO is a computational paradigm based on the idea of collaborative behaviour which is inspired by bird flocking or fish schooling. For the implementation of whole proposed work MATLAB software is used under image processing toolbox.

Keyword: Gabor filter, median filter, face recognition, and PSO

I. INTRODUCTION

Feature detection is a very common process in image analysis. So this is a true challenge to build an automated system which can detect facial features automatically. Feature detection of face tells the shape and size of the face, and the rest of part of body is ignored. Researchers may consider the feature detection as localization of faces. In recognition of face, bitwise matching is done with selected images that are present in database. If sometimes facial expressions are changed then this may create problem in detecting and matching the features. Various properties of face for example age of person, sex, hair style, and other facial expressions are responsible for difficulties in face recognition process.
Recognition process is divided into two sub process:

1. Face identification and
2. Face verification.

As from the name "Face identification" it is clear that it all about the identity of faces. This is also named as one to many matching, which means that it matches the one selected image with all other images that are stored in the database. In this input is given to the system in the form of image and the system matches that input image with other database images, after that is identified the person if the input image is matched with any one of the database images. If the image does not find any match, no results are found. On the other hand, Face verification in the recognition process is proposed for verification purpose. This is named as one to one matching. Also, face recognition techniques could be divided into two categories:

- Geometric approach
- Photometric approach

Geometric techniques look at distinguishing individual facial features such as eyes; nose; mouth and head outline. It is developed a model of face based on position and size of these characteristic. Then Photometric approaches are statistical techniques that distil an image into values and compare these values with templates.
Most popular face recognition methods include Eigen faces Fisher faces, Hidden Markov Models, the neuronal model Dynamic Link Matching and connectionist approaches. Face recognition technologies have a variety of application areas such as access control systems; surveillance systems and some law enforcement areas. The facial recognition systems can be incorporated into more complex biometric systems; to achieve a better person authentication. To approached the face recognition domain in our previous works. In Eigen face, the Eigen vector with highest Eigen value captures the dimension with maximum variance and significant details about point can be retrieved from coefficients of the top Eigen vector when investigating the value of its coefficient variables. Eigen vector method is based on coefficient of top k Eigen vectors. Our method introduced a continuous model for facial feature extraction, representing the two dimensional face images by a differentiable function and replacing the covariance matrix by a linear symmetric operator.
In this paper a new face recognition system is proposed using Gabor and Gaussian filtering. A basic face recognition system comprises of 3 steps which are detection of face, extraction of features and the last step is matching the detected face with stored images in the database [4]. The first two steps can run in parallel at the same time. The first step that is face detection extracts the faces from image or video sequence and then marks that area as face. The second step feature extraction helps in extracting various facial features like spacing between eyes, ears etc. The last step recognizes the faces from stored databases of images. Human cannot remember lot of faces and their features. Human limitations are overcome by the computers, which has large amount of memory and computational speed. Therefore common approach

when using Gabor filters for face recognition is to construct a filter bank with filters of different scales and orientations and to filter the given face image with all filters from the bank. Unlike other work found in the literature, which primarily deals with the problem of effectively reducing the size of the Gabor face representation once this has already been computed, this paper takes a different approach and tries to propose a way of deriving a more compact representation. Using the original filter bank of Gabor filters for the derivation of the Gabor face representation, we propose to employ novel orthogonal filters constructed as a linear combination of the original Gabor filters. As shown in the experimental section, these filters are capable of achieving similar recognition rates than the original ones, but using a far more compact face representation.

II. GABOR FILTER

Gabor filters are among the most popular tools for facial feature extraction. And Gabor filter used in automatic face recognition system is motivated by two major factors: their computational properties and their biological relevance. It is obvious that the mathematical properties of the Gabor filters crucially influence the characteristics and size of the Gabor face representation. For the extraction of features of face well known tool is used and Gabor filter is one of them. There are two main features of Gabor filters which can cause automatic detection of face features. These features are regarding relevance of biology and properties of computation. It is very clear that properties related to mathematics of these filters are critically impact the properties of representation of Gabor face and discussions are done in detail. There are many literatures available on the internet which works on Gabor filters for recognition of face which facilitates the fact to provide some properties regarding face which are location in space and frequency domain, knowledge of orientation. Space and frequency domains are used to find the location [12]. It is not always required that these properties are considered to be important. These can be applied as undoubtedly interesting. Filters are used as an ideal resolution in frequency and spatial domains, in such a way that it is necessary to define the features of local spatial components of narrow band of frequency. When Gabor filter is used on the input image of face of normal size then it's output in Gabor is considerable greater in size as compare to normal image. One of the well-known disadvantages of Gabor is that the filters which are dissimilar to one another from the database are not always perpendicular to other filters present in database. In the final representation of Gabor information which is in encoded form is usually similar as previous that is why it causes some difficulties in calculating the performance of Gabor representation of face [12]. Gabor filters have also some shortcomings which crucially affect the characteristics and size of the Gabor representation of a given face pattern. Therefore amongst these shortcomings the fact that the filters are not orthogonal one to another and hence; correlated is probably the most important. It made the information contained in the Gabor face representation redundant and also affects the size of the representation. Therefore overcome this problem we propose in this paper to employ orthonormal linear combinations of the original Gabor filters rather than the filters themselves for deriving the Gabor face representation. Then filters named principal Gabor filters for the fact that they are computed by means of principal component analysis; are assessed in face recognition experiments performed on the XM2VTS and Yale B databases; where encouraging results are achieved. This paper also addresses on noisy images and introduces a new filter, named "fuzzily skewed filter" for noise suppression, which swallows the advantages of both the median filter and averaging filter. The Despite robustness Gabor and Median filter based feature selection methods are normally computationally expensive due to high dimensional Gabor features. To reduce feature dimension, this paper uses Gabor and Gaussian filters; for scaling and orientations.

Face recognition system structure:

Face Recognition is a term that includes several sub-problems. Therefore there are different classifications of these problems. Finally, a general or unified classification will be proposed:

A generic face recognition system:

The input of a face recognition system is always an image or video stream. Then output is an identification or verification of the subject or subjects that appear in the image or video. A few approaches define a face recognition system as a three step process - see Figure1. To this point of view; the Face Detection and Feature Extraction phases could run simultaneously.

Figure 1: The generic face recognition system.

Face detection is defined as the process of extracting faces from scenes. The system positively identifies a certain image region as a face. The procedure has more applications like face tracking; pose estimation or compression. Then the next step -feature extraction- involves obtaining relevant facial features from the data. This feature could be certain face regions; variations; angles or measures; which can be human relevant (e.g. eyes spacing) or not. This phase has other applications like facial feature tracking or emotion recognition. Then finally; the system does recognize the face. To an identification task; the system would report an identity from a database. Thus this phase involves a comparison method; a classification algorithm and an accuracy measure. Therefore this phase uses method common too many other areas which also do few classification process -sound engineering; data mining et al. All these phases can be merged; or new ones could be added. At last could find more different engineering approaches to a face recognition problem. Then Face

detection and recognition could be performed in tandem; or proceed to an expression analysis before normalizing the face

Face detection:

A nowadays application of Face Recognition does not require face detection to some extent. In some cases database images are already normalized. The images have no need to change. They are already in useable format. For example, criminal information database is an example of this system. Criminal record is stored along with images by law agency. Whenever the police gets a new case and picture of his or her is already with them then they don't need face detection. But, the predictable input images of systems are not that appropriate. They can enclose many items or faces. In this case face detection is compulsory. It is also unavoidable if we want to develop a computerized face tracking system [5]. Then Face detection must deal with many well known challenges. Those are usually represented in figure captured in uncontrolled environments; such as surveillance video systems. Then these challenges can be attributed to few factors such as Pose variation. Then ideal scenario for face detection would be one in which only frontal images were involved. But as stated it is very unlikely in general uncontrolled conditions.

Facial expression:

Facial features also vary greatly because of different facial gestures and figure condition. Many different cameras and ambient conditions can affect the quality of an image; affecting the appearance of a face. There are some problems closely related to face detection besides feature extraction and face classification. To instance; face location is a simplified approach of face detection. Then this goal is to determine the location of a face in an image where there's only one face. We can differentiate between face detection and face location; since the latter is a simplified problem of the former. Methods like locating head boundaries were first used on this scenario and then exported to more complicated problems. Facial feature detection concerns detecting and locating some relevant features such as nose; eyebrow; lips; ear and etc. Some feature extraction algorithms are based on facial feature detection. Then Face tracking is another problem which sometimes is a consequence of face detection. More systems' goal is not only to detect a face; but to be able to locate this face in real time. To again; video surveillance system is a good example.

Face detection problem structure:

Face Detection is a concept that has many sub-problems. There are few systems which detect and locate faces at the same time and on the other hand other systems first perform a detection routine and then; if positive; they try to locate the face. Then, some tracking algorithms may be needed - see Figure.

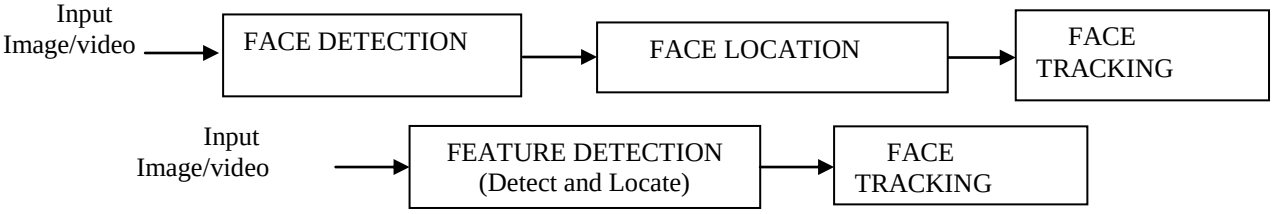

Figure 2: Face detection processes.

All the face detection algorithms usually share common steps. Then firstly; some data dimension reduction is done; in order to achieve a admissible response time. A few preprocessing could also be done to adapt the input image to the algorithm prerequisites. Some algorithms analyze the image as it is; and some others try to extract certain relevant facial regions. The next phase usually involves extracting facial features or measurements. Therefore these will then be weighted; evaluated or compared to decide if there is a face and where is it. At last in some algorithms have a learning routine and they include new data to their models. Then Face detection is therefore; a two class problem where we have to decide if there is a face or not in a picture. It is an approach can be seen as a simplified face recognition problem. Face recognition has to divide a given face; and there are as many classes as candidates. Many face detection methods are very similar to face recognition algorithms. Out put another way; techniques used in face detection are often used in face recognition.

III. PARTICLE SWARN OPTIMIZATION

Particle Swarm Optimization (PSO) is a swarm intelligence technique developed by Dr. Eberhart and Dr. Kennedy in 1995. In PSO, the swarm consists of particles which move around the solution space of the problem. These entire particles search for the optimal solution of the problem in the predefined solution space till the convergence is achieved. Particle swarm optimization is not same as genetic algorithm in method of sharing. In genetic algorithms information is shared in such a way that the whole population of a habitat moves to form a group from one geographical area to another. In particle swarm optimization, optimal particle is picked from the group of swarms for the sharing of information among particles. Information is shared in such a way that it is only one directional information sharing. Information is either received or sent at one time. PSO has less computational time because its ability to attain the optimal solutions The algorithm is applied DWT feature vectors and is used to search for the optimal feature subset to increase recognition rate and class separation. Evaluation of the proposed algorithm using the ORL face database and comparing its performance with a PCA, ICA LDA feature selection algorithm and various FR algorithms found in the literature.

The basic functionality of particle swarm optimization algorithm can be understood with the following 3 steps only [10].

1. Estimate the position of every particle
2. Keep updating the local and global values of all particles in the swarm
3. Adjust the values of positions of all particles

PSO algorithm:

• To initialize the particle position by assigning location p = (p0, p1…., pN) and velocities v = (v0,v1, …,vN).
•To determine the fitness value of all the particles: f (p) = (f (p0), f (p1)… f (pN)).
• To evaluate the location where each individual has the highest fitness value so far: p= ($p0^{best}$, p1best… pNbest).
• To evaluate the global fitness value which is best of all p^{best}: G (p) = max (f (p)).
The particle velocity is updated based on the p^{best} and g^{best}.
• v_i new = v1 + c1 × rand ( ) × (p_i^{best} - pi) + c2 × rand ( ) × (p_g^{best} - pi)
For 1 < i< N. (1)
• And where c1 and c2 are constants known as acceleration coefficients and rand () are two separately generated uniformly distributed random numbers in the range [0, 1].
• Then Update the particle location by: $p_i^{new} = pi + v_i^{new}$ for 1 < i < N.
• ThereforeTerminate if maximum number of iterations is attained or minimum error criteria is met.
• Go to step 2.

Binary PSO:

For binary discrete search space; Kennedy and Eberhart have adapted the PSO to search in binary spaces by applying a sigmoid transformation to the velocity component in the equation to squash the velocities into a range [0,1] and force the component values of the positions of the particles to be 0's or 1's.
Then sigmoid expression is given by:

$$sigmoid\left(p_{id}^{k}\right) = \frac{1}{1 - e^{-v_{id}^{k}}} \quad (1)$$

$$\left(p_{id}^{k}\right) = \begin{cases} 1 & if\ rand(\ \ ) < sigmoid\left(p_{id}^{k}\right) \\ 0 & otherwise \end{cases} \quad (2)$$

Feature Extraction:

Feature extraction is a spatial process in pattern recognition as well as in image processing. When the large input data is given to an algorithm for processing and it is suspected to that data as the same measurement in both feet and meters. And then the input data will be transformed into set of features which is also named as features vector. Therefore transforming the input data into the set of features is called feature extraction. When we are talked about the process of face recognition, the main step is the extraction of the feature matrix. There are so many different algorithms present which are used for feature extraction.

Feature selection using binary PSO:

Feature selection is performed to reduce the dimensionality of facial image so that the features extracted are as representative as possible. The method employed here is Binary PSO. To consider a database of L subjects or classes, each class W1, W2, W3… WL with N1; N2; N3…NL number of samples. Take M1, M2, M3... ML is the individual class mean and M0 be mean of feature vector. The Fitness function is defined so as to increase the class separation equation. To minimizing the fitness function; class separation is increased. To iteration the most important features are selected. Binary value of 1 of its position implies that the feature is selected as a distinguishing feature for the succeeding iterations and if the position value is 0 the feature is not selected.

IV. RESULT AND DISCUSSION

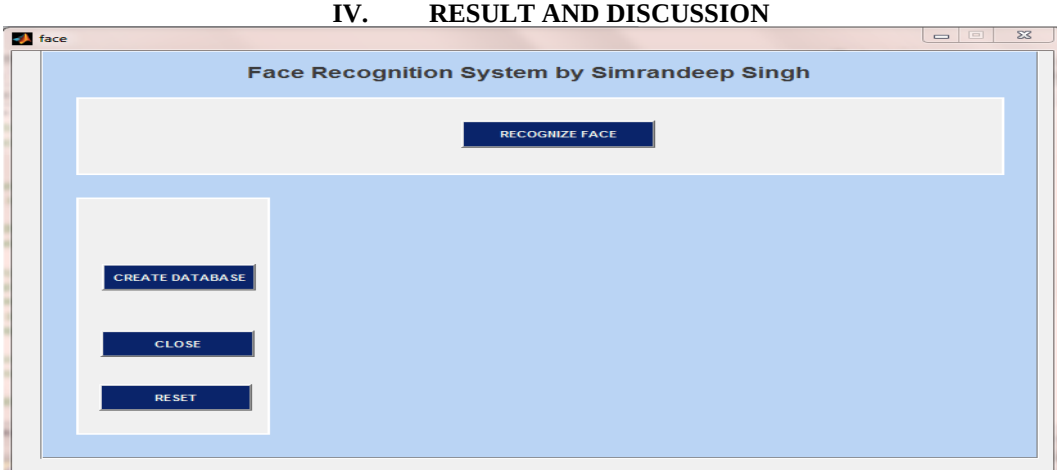

Figure 1: Face recognition GUI layout

Figure 2: To create database in GUI

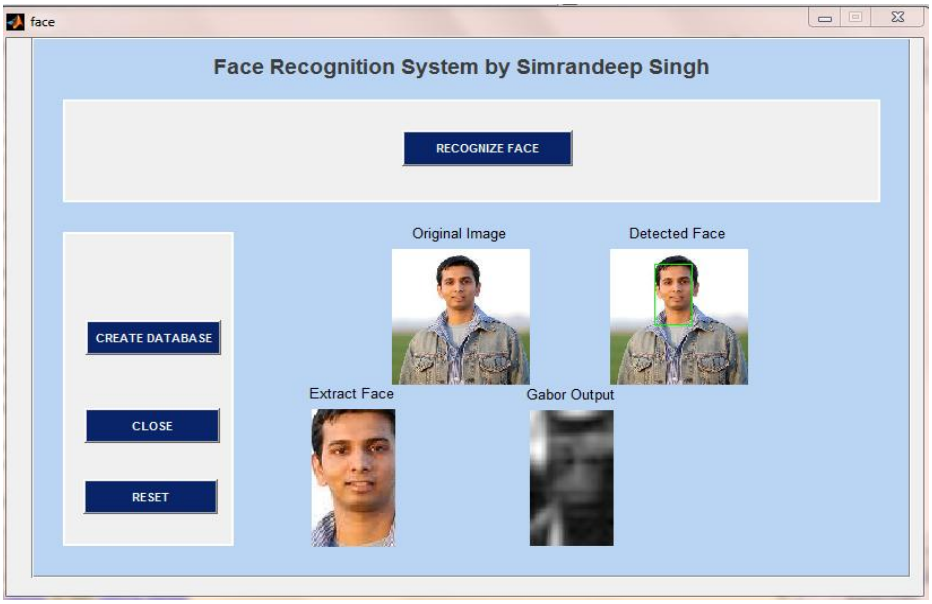

Figure 3: Processing of detection face

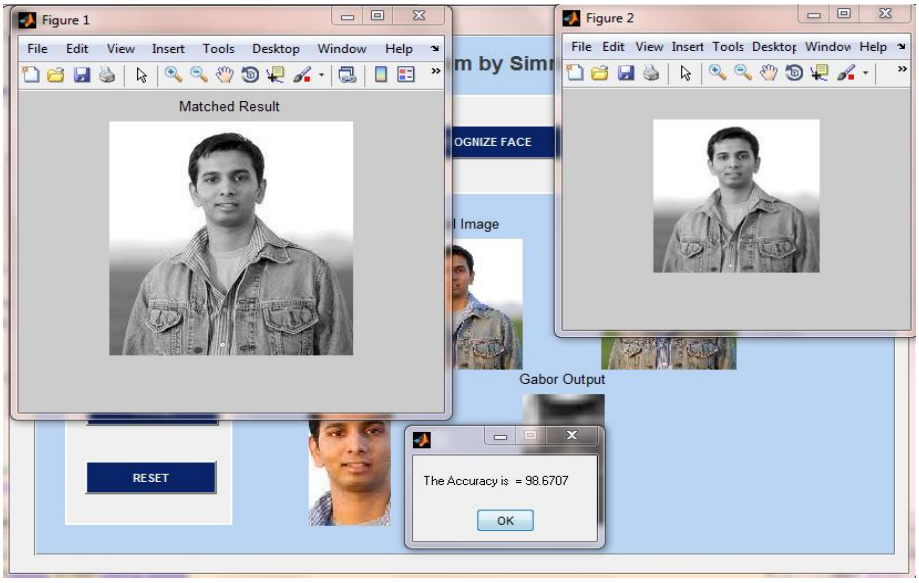

Figure 4: GUI with matched result with accuracy

The above figure shows the result of above technique which discuss in above. This technique is best technique as compare to previous technique. This technique is good for face recognition with many figures database. Its accuracy is upto 98.6707%.

V. CONCLUSION

The proposed framework can be analyzed in terms of feasibility and acceptance in the industry. Therefore trying to improve the performance of existing methods and introducing the new methods for face reorganization based on today's software project requirements can be future works in this area. So the research is on the way to combine different techniques for calculating the best estimate. According to the techniques of the research; it should be stated that having the appropriate combine Gabor filter with PSO technique to find the best method for face reorganization.. The images are transformed by the same procedure that the templates are generated, and they are compared with the templates for final identification. This technique gives better result as compare to previous techniques. By using this technique improve accuracy.

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