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Enhancement of the Face Recognition Using Gabor Filter

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***Abstract*— In the industry the major challenge is to match the infrared face images to the optical face images. The problem arises of the variation between two images (modality gap). Gabor filters have proven themselves to be a powerful tool for facial feature extraction. An abundance of recognition techniques presented in the literature exploits these filters to achieve robust face recognition. However, while exhibiting desirable properties, such as orientation selectivity or spatial locality, Gabor filters have also some shortcomings which crucially affect the characteristics and size of the Gabor representation of a given face pattern. This is because of the infrared image captured by inferred imaging device and optical image captured by optical imaging device. To reduce the modality gap between infrared and optical images one method is use. Common feature discriminant analysis this method improves infrared-optical face recognition performance. This method provides extract the common features from heterogeneous face images, (infrared face image and optical face images).Second matching method is applied to resulting features to obtain final decision.**

***Keywords*— Gabor filter, Gabor wavelet, PCA, Principle Gabor Filter, Eigen images.**

I. Introduction

In the last several years, automatic face recognition technology has developed rapidly for the need of surveillance and security, human-computer intelligent interaction, access control, telecommunication and digital libraries, and smart environments. A successful face recognition algorithm aims at representing the facial feature effectively and extracting the most discriminant information from the face images. Numerous algorithms have been proposed for face recognition, such as principal component analysis (PCA) [1] and linear discriminant analysis (LDA) [2], independent component analysis (ICA) [3] and so on. Simultaneously, Gabor wavelets have proven to be good at local and discriminate image feature extraction as they have similar characteristics to those of the human visual system.

Gabor wavelet transform [10–13] allows description of spatial frequency structure in the image while preserving information about spatial relations which is known to be robust to some variations, e.g., pose and facial expression changes. Although Gabor wavelet is effective in many domains, it nevertheless suffers from a limitation. The dimension of the feature vectors extracted by applying the Gabor wavelet to the whole image through a convolution process is very high. To solve this dimension problem, subspace projection is usually used to transform the high dimensional Gabor feature vector into a low dimension one.

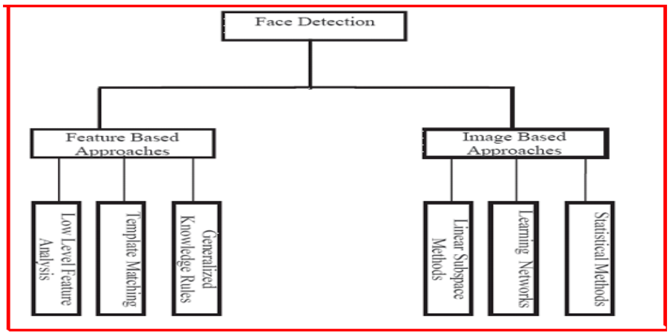

Figure 1.Face detection classification

II. Challenges In Face Detection

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it. Face detection is the problem of determining whether a sub-window of an image contains a face. Looking from the point of view of learning, any variation which increases the complexity of decision boundary between face and non-face classes will also increase the difficulty of the problem. For example, adding tilted faces into the training set increases the variability of the set, and may increase the complexity of the decision boundary.

• ***Image plane*** variation is the first simple variation type one may encounter. Image transformations, such as rotation, translation, scaling and mirroring may introduce such kind of variations.

• ***Pose variations*** can also be listed under image plane variations aspects. However, changes in the orientation of the face itself on the image can have larger impacts on its appearance.

• ***Lighting*** variations may dramatically change face appearance in the image. Such variations are the most difficult type to cope with due to fact that pixel intensities are directly affected in a nonlinear way by changing illumination intensity or direction.

• ***Background variation*** is another challenging factor for face detection in cluttered scenes. Discriminating windows including a face from non-face is more difficult when no constraints exist on background.

III. EXISTING WORK

There are numerous face recognition techniques that have been projected in the past 30 years. For this topic (see [4] for a review), these existing techniques are being divided into different classes. The subsequently given below are some possible high level classifications:

Holistic meathod are used further processing. A famous example of this method is PCA-based approach presented by Sirovich[5] and Kirby, followed by Pentland [6] and Turk.

For extracting local features which are nose, ears, eyes and lips, the Local Feature-based Methods are used. Their positions and local look are key to the recognition phase. For example, Elastic Bunch Graph Matching (EBGM) [7][1][14] proposed this work.

In 1960, digital image processing started with semi-automated systems [10]. In order to locate the major features different marks were made on photographs. Semi-automated systems have used features like mouth, eyes and nose. Next, in order to get the common reference point, the ratios and distances were calculated from these calculations and the calculations were compared with the database. In 1970's, Harmon, Goldstein and Lesk [9] introduced their system. The system had 21 subjective markers having lip thickness and hair color. This was difficult while automating the system because of the many complex measurements were completely made by hand. After the Goldstein paper, Fisher and Elschlagerb projected a new advancement to face recognition [11]. This technique calculated the features of face by using above templates. Finally, they were mapped onto a global template. The research resulted in the conclusion that an adult face does not contain much unique data. Another approach is Connectionist technique, is used to categorize human face using two things which are gestures and a set of classifying markers. This technique is normally applied on neural network principles and 2-dimensional pattern recognition. In neural networks a huge training database of faces is needed which required too much time to train the whole system to get the desired results.

The proposed technique is mechanized for general pattern recognition. This compare faces with a general face model in a single face which creates a series of patterns. The statistical approach relies on grayscale value.

IV. PROPOSED WORK

The proposed system uses Gabor filters for face recognition. The maximum intensity points dynamically on each filtered image are found and are marked as fiducially points. If the distance is minimum between these face points then system reduces [13] the points. After that the system accesses the database and recognizes the image if the distance between points gets matched.

FEATURE EXTRACTION

Feature extraction algorithm for the proposed method has two main steps:

(1) Feature point localization,

(2) Feature vector computation.

1 FEATURE POINT LOCALIZATION

First, feature vectors are extracted from points with high information content on the face image. In most feature-based methods, facial features are assumed to be the eyes, nose and mouth. However, we do not fix the locations and also the number of feature points in this work. The feature vectors and their locations can vary in order to better represent diverse number of facial characteristics of different faces, such as dimples, moles, etc.

From the responses of the face image to Gabor filters, peaks are found by searching the locations in a window W0 of size WxW by the following procedure: A feature point is located at (x0, y0), if

2 FEATURE VECTOR GENERATIONS

$$v_{i,k} = \{x_k, y_k, R_{i,j}(x_k, y_k)\ j = 1,\ldots\ldots,40\}.$$

$(x,y)\in W_0$

While there are 40 Gabor filters, feature vectors have 42 components. The first two components represent the location of that feature point by storing (x, y) coordinates. Since we have no other information about the locations of the feature vectors, the first two components of feature vectors are very important during matching (comparison) process. The remaining 40 components are the samples of the Gabor filter responses [12,15] at that point. Although one may use some edge information for feature point selection, here it is important to construct feature vectors as the coefficients of Gabor wavelet transform. Feature vectors, as the samples of Gabor wavelet transform at feature points, allow representing both the spatial frequency structure and spatial relations of the local image region around the corresponding feature point.

The Gabor representation of a face image is computed by convolving the face image with the Gabor filters. Let f(x, y) the intensity at the coordinate (x, y) in a gray scale image face image,its convolution with a Gabor filter ψf, θ (x,y) is defined as

$$g_{f,\theta}(x,y) = f(x,y) * \psi_{f,\theta}(x,y)$$

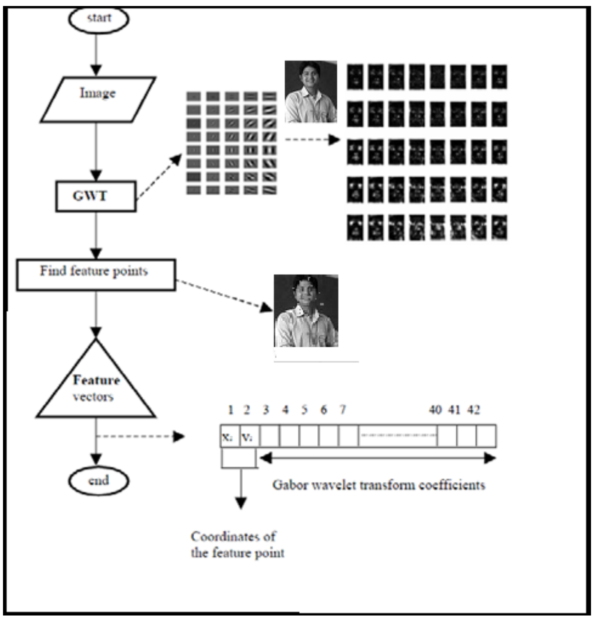

Figure 2: Flowchart of the feature extraction stage

V. CONCLUSIONS AND FUTURE WORK

A. CONCLUSIONS:

Face detection and recognition has been an attractive field of research for both neuroscientists and computer vision scientists. Humans are able to identify reliably a large number of faces and neuroscientists are interested in understanding the perceptual and cognitive mechanisms at the base of the face detection process.

. Since 1888, many algorithms have been proposed as a solution to automatic face detection. Although none of them could reach the human detection performance, currently two biologically inspired methods, namely eigenfaces and elastic graph matching methods, have reached relatively high detection rates. Eigenfaces algorithm has some shortcomings due to the use of image pixel gray values. As a result system becomes sensitive to illumination changes, scaling, etc. and needs a beforehand pre-processing step. Satisfactory recognition performances could be reached by successfully aligned face images. When a new face attends to the database system needs to run from the beginning, unless a universal database exists. The method uses Gabor wavelet transform& feed forward neural network for both finding feature points and extracting feature vectors. From the experimental results, it is seen that proposed method achieves better results compared to the graph matching and eigenface methods, which are known to be the most successive algorithms.

Proposed method is also robust to illumination changes as a property of Gabor wavelets, which is the main problem with the eigenface approaches. A new facial image can also be simply added by attaching new feature vectors to reference gallery while such an operation might be quite time consuming for systems that need training. Feature points, found from Gabor responses of the face image, can give small deviations between different conditions (expression, illumination, having glasses or not, rotation, etc.), for the same individual. Therefore, an exact measurement of corresponding distances is not possible unlike the geometrical feature based methods. Moreover, due to automatic feature detection, features represented by those points are not explicitly known, whether they belong to an eye or a mouth, etc.

B. FUTURE WORK:

Although detection performance of the proposed method is satisfactory by any means, it can further be improved with some small modifications and/or additional pre-processing of face images. Such improvements can be summarized as;

1) Since feature points are found from the responses of image to Gabor filters separately, a set of weights can be assigned to these feature points by counting the total times of a feature point occurs at those responses.
2) A motion estimation stage using feature points followed by an affined transformation could be applied to minimize rotation effects. This process will not create much computational complexity since we already have feature vectors for recognition. By the help of this step face images would be aligned.
3) As it is mentioned in problem definition, a face detection algorithm is supposed to be done beforehand. A robust and successive face detection step will increase the detection performance. Implementing such a face detection method is an important future work for successful applications.
4) In order to further speed up the algorithm, number of Gabor filters could be decreased with an acceptable level of decrease in detection performance. It must be noted that performance of detection systems is highly application dependent and suggestions for improvements on the proposed algorithm must be directed to a specific purpose of the face detection application.

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