

REVIEW STRATEGY FOR FACE RECOGNITION USING GABOR FILTER

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ABSTRACT

This paper describes a face detection method using Artificial Neural Network (ANN) and Gabor filters. This method achieves rotation invariant and extremely high face detection rate using Gabor wavelets. Gabor filter have optimal localization properties in both spatial and frequency domain. By using these desirable characteristics, Gabor filters extract facial features from the local image. These extracted features work as the input to image classifier which is a Feed Forward Neural Network (FFNN). Gabor feature has been widely recognized as better representation for face recognition in terms of rank-1 recognition rate. In this paper, we view the strength of Gabor feature for face recognition from the new angle of its robustness to mis-alignment using an overall quantificational evaluation method combining both the alignment precision and the recognition accuracy. Our experiments show that, compared with the gray-level intensity, Gabor feature is much more robust to image variation caused by the imprecision of feature localization, which further support the feasibility of Gabor representation. This network works on a reduced feature sub space learned by an approach simpler than principal component analysis (PCA). Face classification is currently implemented in software. This study gives an impression of Gabor filters in image processing and emphasis on its characteristics of spatial locality and orientation selectivity.

Keyword: Gabor filter, Gabor wavelet, PCA, Principle gabor filter, Eigen images.

1. INTRODUCTION

Face recognition is an active research area with a wide range of applications in the real world. In the recent years, a defined face recognition pipeline, consisting of four steps i.e. detection, alignment, representation, and classification has been presented. In the detection step the place of the image including face is found. The alignment step ensures the detected face is lined up with a target face or a model. In the representation step the detected face is described in a way that several descriptions with certain aspects about the detected face are presented. Finally, the classification step determines whether a certain feature corresponds with a target face or a model [1]. Face recognition techniques are divided into Geometric and Photometric approaches. Geometric approaches consider individual features such as eyes, nose, mouth and a shape of the head and then develop a face model based on the size and the position of these characteristics. In photometric approaches the statistical values are extracted, subsequently, these values are compared with the related templates. A large number of researches have been devoted to feature extraction based on Gabor filter [2,3]. A face representation using the Gabor filter, has been of focal

importance in the machine vision, image processing and pattern recognition [4]. In the face recognition, the feature representation of a face is a critical aspect. If representation step does not perform well, even the best classifiers cannot produce appropriate results.

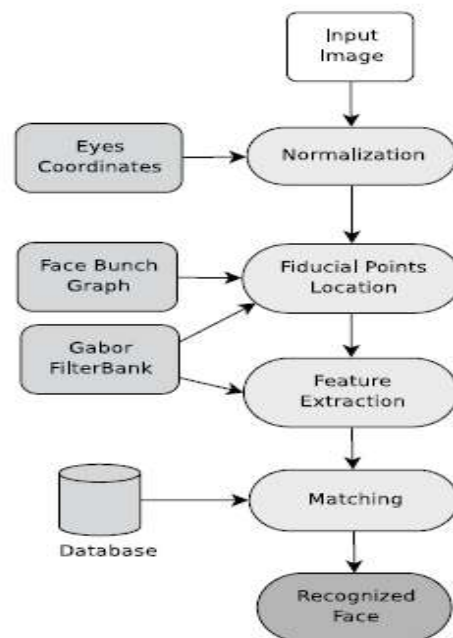


Figure1: Feature Extraction Property

II CHALLENGES IN FACE DETECTION

Face detection[5,6] 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 REVIEW ON TECHNIQUES

This section reviews the techniques [9] used for the feature extraction in the face recognition and their related performance characteristics in detail.

3.1. First Technique

The Gabor filter, an image processing tool, applied broadly to the feature extraction, stores the information about the digital images [14]. This technique addresses a new algorithm using a neural network which is trained by the extracted features of the Gabor filters. The novel approach of this technique is scaling RMS contrast and presenting fuzzily skewed filtering. Initially the original images are converted into the gray-level images and cropped into 100×100 pixel images. By determining the centre of the two eyes for each face, then the face images are rotated [2]. The pre-processing phase of the related technique has three steps: contrast and illumination equalization, histogram equalization and fuzzy filtering [12].

3.1.1. Contrast and Illumination Equalization

RMS measuring is of great interest in the related area because it produces an appropriate recognition performance. Moreover it uses fuzzily skewed filtering to suppress the noise in the images [10]. Due to the different lighting conditions, the images might have a poor contrast, therefore all of the images are processed with the same illumination and the same RMS contrast to reach a significant representation.

3.1.2. Fuzzily Skewed Filtering

It should be noted that sometimes different sources make an imperfection on the images, i.e. details of the image representation with a high frequency are disturbed by the noise [10]. In order to overcome such a disturbance, a new filter namely fuzzily skewed filter which has been used for the noise suppression. It has the advantages of both the median and the averaging filters. The value of each pixel is appointed by setting fuzzy rules and the neighbourhood gray-level values of the pixels. There are 3 steps to determine the pixel value [11].

- 1) Determining an $n \times n$ neighbourhood for each pixel, and sorting the gray level values in an ascending or descending order.
- 2) Defining a membership function for the pixels of the neighbouring region according to a-c steps 4
 - a) Pi-shaped membership function is defined.
 - b) A value of 0 is assigned to the highest and the lowest gray-level values.
 - c) A membership function value of 1 is assigned to the mean value (i.e. averaging on the gray-level values in the neighbourhood of the pixels).
- 3) Returning the highest value of the membership function as an output.
- 4) Only pixels $2 \times k + 1$ ($k \leq n$) are considered, k is the range value meaning that the number of the pixels that contributed to the skewing process of the stored pixels list.

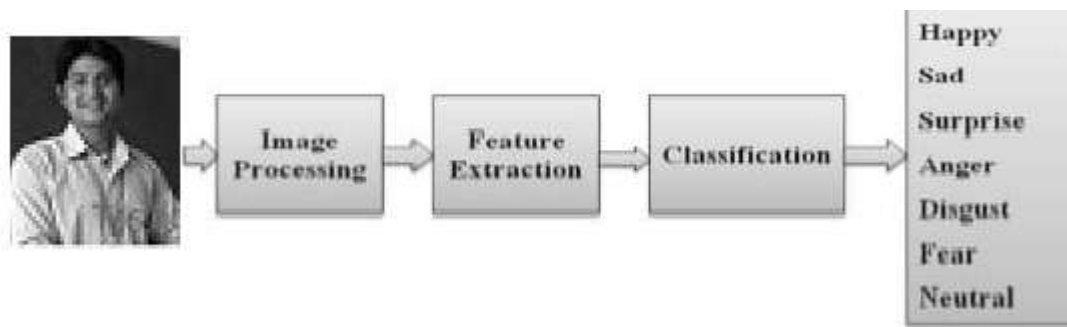


Figure2: Feature extraction classification of Facial expression

IV CONCLUSION & FUTURE WORK

In this paper, a new approach to face detection with Gabor wavelets & feed forward neural network is presented. 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. In the proposed algorithm, since the facial features are compared locally, instead of using a general structure, it allows us to make a decision from the parts of the face. For example, when there are sunglasses, the algorithm compares faces in terms of mouth, nose and any other features rather than eyes. Moreover, having a simple matching procedure and low computational cost proposed method is faster than elastic graph matching methods. 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.

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

- 1) 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) When there is a video sequence as the input to the system, a frame giving the “most frontal” pose of a person should be selected to increase the performance of face detection algorithm.
- 3) In order to further speed up the algorithm, number of Gabor filters could be decreased with an acceptable level of decrease in detection performance.

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