FACE DETECTION/RECOGNITION USING GABOR FILTER THROUGH ANN

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Abstract-

This paper based on classification of the feature of a face detected using Gabor filter feature extraction techniques in image processing. The face recognition problem is made difficult by the great variability in head rotation and tilt, lighting intensity and angle, partial occlusion etc. the feature vector based on Gabor filter is used as the input of the classifier, which is a feed forward neural network on a reduced feature subspace learned by an approach simpler then the PCA(principal component analysis).the system is commenced on convolving a face image with a series of Gabor filter coefficient at different scales and orientation. The effectiveness of the algorithm has been justified over a face database with images captured at different illumination conditions.

Keywords-Gabor filter, Face detection, neural network, Feed forward network.

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1.Introduction-Human face detection and recognition is an active area of research spanning several disciplines such as image processing, pattern recognition and computer vision [8]. Face recognition and detection are preliminary step to a wide range of application such as personal identity verification, video confessing etc. most methods are based on neural network approach in which neural network is used to both extract the feature and to detect the faces. This approach works well to detect single face image but does not work well to detect number of faces in a single image. It takes more time to detect number of faces in a single image.

This paper technique is developed to detect the faces in group image by using Gabor filter to extract the feature and neural network to classify the faces [6]. The feature vector based on Gabor filter is used as the input of the face or non-face classifier, which is a artificial neural network. In this paper the design of ANN algorithm in order to achieve image classification [4]. A related and important problem is how to evaluate the performance of the proposed detection methods. Many recent face detection papers compare the performance of several methods, usually in terms of detection and FAR (false alarm rate).

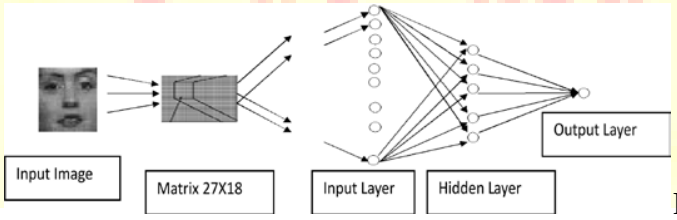


Fig1. Architecture of Proposed System

A face recognition system [1] comprises two stages: Training and Testing. In practical application, the small number of available training face images and complicated facial variation during the testing stage are the most difficult problems for current face recognition systems. In general, detectors can make two types of errors: false negative in which faces are

missed resulting in low detection rates and false positive in which an image is declared to be face.

False Negative=No. of missed faces/total no. of actual faces

False positive=No. of incorrect detected faces/total No. of actual faces.

Face detection can be viewed as two class recognition problem in which an image region is classified as being a face or non-face. Face detection also provide interesting challenges to the underlying pattern classification and learning techniques [8]. The classes of face or non-face image are decidedly characterized by multi model distribution function and effective decision boundaries are likely to be non-linear in the image space. The implementation of an ANN algorithm and design of a Gabor filter in order to provide better image classification.

2. Multilayer Preceptron- A neural network is an information processing system that has been developed as generalization of mathematical models matching human recognition [8]. They are composed of a large number of highly interconnected processing units (neurons) that work together to perform a specific task. The MLP algorithm is used to classify face and non-face patterns before the recognition step. The MLP neural network has feed forward architecture within input layer, a hidden layer and an output layer.

The input layer of this network has N units for an N dimensional input vector. The input units are fully connected

To the I hidden layer units, which are in turn, connected to the J output layers units, where J is a number of output classes.

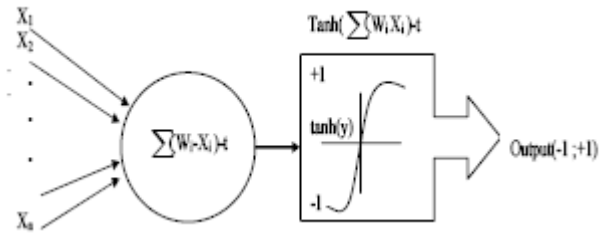


Fig2. Neurons of supervised training

3. Training Methodology-The MLP with the training algorithm of feed propagation is universal mappers, who can in theory [I,8], approximate any continuous decision region arbitrarily well. Yet the convergence of feed forward algorithms is still an open problem. It is well known the cost of feed forward training often exhibits a remarkable variability. It has been demonstrated that, in most cases, rapid restart method can prominently suppress the highly tailed nature of training instances and improve efficiency of computation.

Multi layer Preceptron (MLP) with a feed forward learning algorithm was chosen for the proposed system because of its simplicity and its capability in supervised pattern matching. It has been successfully applied to many pattern classification problems [5]. Our problem has been considered to be suitable with the supervised rule since the pair of input output are available for training the network.

4. Working-The effectiveness of the proposed method is demonstrated by experiments on a large number of images. We show that using both of the magnitude and phase of Gabor filter response as features, the detection performance is better than that using magnitude only, and using the real part only also performs fairly well. Retinally connected neural network examines small windows of an image, and decides whether each window contains a face. The system arbitrates between multiple networks to improve performance over a single network.

5. Design of Gabor Filter-Gabor filter is applied for face recognition [6]. Face representation using Gabor features has been attracted considerable attention in computer vision, image processing, pattern recognition etc.[4] the principal motivation to use Gabor filter is biological relevance that the receptive field profiles of neurons in the primary visual cortex of mammals are oriented and have characteristic spatial frequencies. Gabor filter can exploit salient visual properties such as spatial localization, orientation selectivity, and spatial frequency characteristics.[4] Gabor filter works as a band pass filter for the local spatial frequency distribution, achieving an optimal resolution in both spatial and frequency domains.

$$\psi_{u,v}(z) = \frac{\| \tilde{k}_{u,v} \|^2}{\sigma^2} e^{(-\|k_{u,v}\|^2 \|z\|^2 / 2\sigma^2)} \left[e^{i\tilde{k}_{u,v} z} - e^{-\sigma^2/2} \right], \quad (1)$$

where $k_{u,v} = k_v e^{i\phi_u}$; $k_v = \frac{k_{\max}}{f^v}$ gives the frequency, and $\phi_u = \frac{u\pi}{8}, \phi_u \in [0, \pi)$ gives the orientation, and $z = (x, y)$.

$$k_{u,v} = k_v e^{i\phi_u}, \quad (2)$$

Where $e^{i\vec{k}_{u,v} z}$ is the oscillatory wave function, whose real part and imaginary part are cosine function and sinusoid function respectively. In equation 1, U controls the scale of Gabor filter, which mainly determines the centre of the gabor filter in the frequency domain; v controls the orientation of the Gabor filter.

6. Methodology and algorithm development-

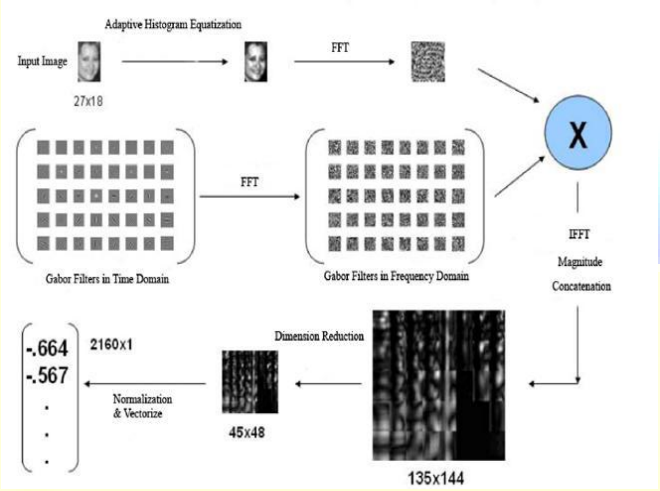


Fig3. Methodology & Algorithm development

6.1 2D Gabor Wavelet representation of faces- Gabor filter, modeling the responses of simple cells in the primary visual cortex, [2,5] are simply plane waves restricted by a Gaussian envelope function.

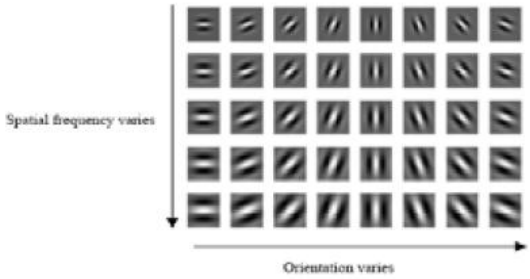


Fig4. Gabor filter correspond to 5 spatial frequencies and 8 orientation

An image can be represented by the Gabor wavelet transform allowing the description of both the spatial frequency structure and spatial relations. Convolving the image with complex Gabor filter with 5 spatial frequency (v=0,1,…..,4) and 8 orientation (μ=0,1,2,……,7) captures the whole frequency spectrum, both amplitude and phase.

6.2 System Modules-

- Create database: In this module there is a function call load images. This function prepares images for training phase. All data from both "face" and "non-face" folders will be gathered in a large cell array. Each column will represent the features of an image which could be a face or not.
- Feature Extraction: Feature Extraction algorithm for the proposed method has two important step in:

Feature point Localization: In this step, 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. The number of feature vectors and their locations can vary in order to better represent diverse facial characteristics of different faces, such as dimples, moles, etc., which are also the features that people might use for recognizing faces from the responses of the face image to Gabor filters.

A feature point is located at (x0, y0), if

$$R_j(x_0, y_0) = \max_{(x,y)\in W_0} (R_j(x, y))$$

$$R_j(x_0, y_0) > \frac{1}{N_1 N_2} \sum_{x=1}^{N_1} \sum_{y=1}^{N_2} R_j(x, y),$$

J=1,2,3,…….,40

Where, Rj is the response of the face image to the jth Gbor filter N1 N2 is the size of face image, the centre of the window, W0 is at (X0, Y0). Window size W is one of the important parameters of proposed algorithm, and it must be chosen small enough to get stuck on a local maximun, instead of finding the peaks of the responses.

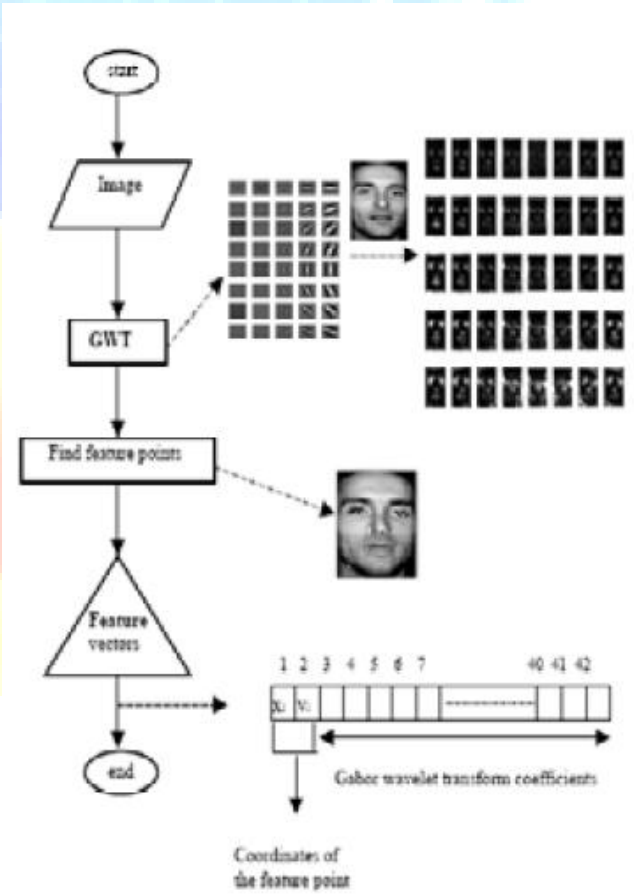


Fig5. Flowchart of the feature extraction stage of the facial images

Feature Vector Generalization: Feature vector are generated at the feature points as a comparison of Gabor wavelet transform coefficients, kth feature vector of the ith reference face is defined as,

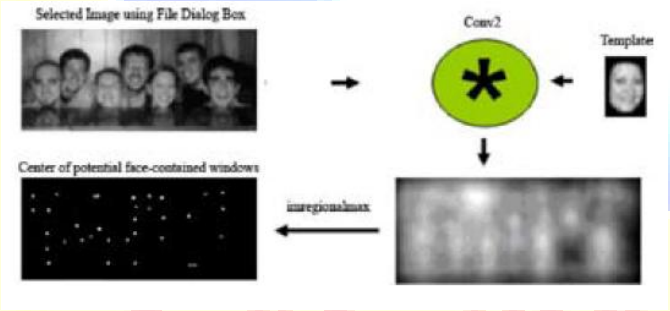
$$v_{i,k} = \{x_k, y_k, R_{i,j}(x_k, y_k)\ j = 1,\ldots,40\}.$$

While there are 40 Gabor filters, feature vectors have 42 components. The first two components represent the location of the feature point by storing (x,y) coordinates.

- Initializes Network: In this module a function, this function will create a feed forward neural network with one hundred neurons in the hidden layer and one neuron in the output layer.

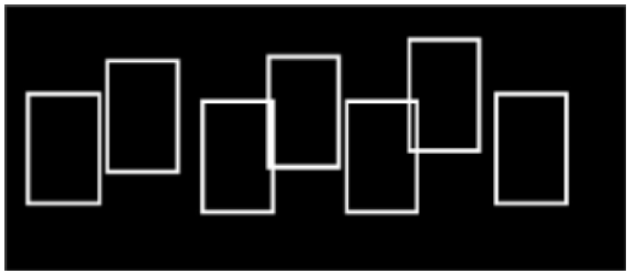
7. Result:

First section-



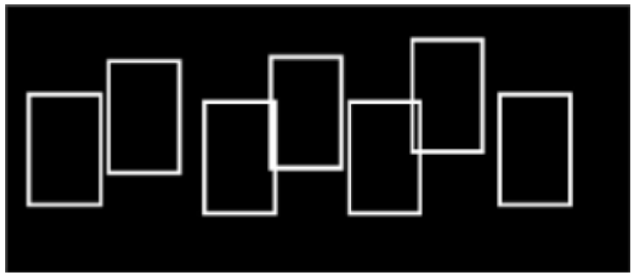
Second section-

Third section-

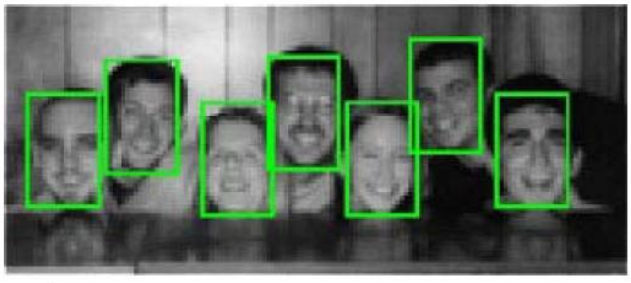


Fourth section-

Fifth section-



Sixth section-



8. Conclusion: Face recognition using Eigen faces has been shown to be quite accurate. Neural network is one of the advanced techniques to make the classification in a better way. In variance due to illumination and expression is Characterized by Gabor filters and recognition rate is Increased as 80 - 90 % range. Main advantage of this method is the recognition is very fast when compared to Other methods. Face recognition can be applied in Security measure at Air ports, Passport verification, Criminals list verification in police department, Verification of Electoral identification and Card Security Measure at ATM's**.**

9. References-

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