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Face Recogition by Using Gabor Feature Extraction and Neural Networks

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***Abstract**: Face recognition is successful by using Gabor filter and neural networks. In this paper we present a biometric system of face detection and recognition in color images. In this 40 different Gabor filters are applied on an image will result 40 different images with different orientations. This paper addresses a novel algorithm in order to detect face features and extract their corresponding geometric points. In those 40 filtered images maximum intensity points are calculated and mark them as fiducially points. To reduce those Fiducially points distance between those points is considered. By using distance formula distances between those reduced points are calculated. Then distances between them are compared with the pre-defined database. If that distance exists that corresponding image will be recognized. The image will be convolved with Gabor filters by multiplying the image by Gabor filters in frequency domain. Face detection and recognition has many applications in a variety of fields such as security systems, video conferencing and identification. The neural Network employed for face recognition is based on the Multi Layer Perception (MLP) architecture.*

***Keywords**: Face recognition, Distance formula, Gabor filter, neural networks, Images*

I. Introduction

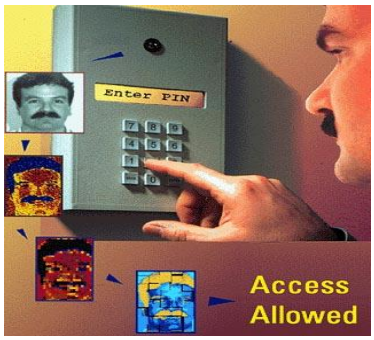
Now a day, many applications used by the civilians and army or police forces require effective face recognition. In this case face recognition is very useful to easily detect the human faces. This face recognition is a very challenging area in computer vision and pattern recognition due to various variations in facial expressions, poses, Illumination, changes in temperature, sweating, aging and skin discoloration. If there are any changes due to injury, fashion etc there is further complexity. Most of the methods are based on neural networks, feature extraction, skin color, and others are based on template matching. Many techniques for face recognition are developed. There are two approaches: geometrical and general methods. Geometrical methods are based on measures extracted between the facial features such as eyes, mouth, nose and chin. In general methods total face is treated as a single. For face detection, we can use PCA, eigenfaces, neural filters and Gabor filters .The points marked on the face by Gabor and neural networks can be compared by pre stored data base of faces. If match occurs, then the face will be detected. If we want high level of security then we can use face detection, cards checking etc.

This type of face recognition system is used in areas such as air ports for the official people and the staff for direct sending them rather than normal people. For any transactions over the internet, we have to remember PIN numbers and password; it is very difficult so, face verification is implemented. It is very useful because pin numbers and passwords can be hacked by any one. Face recognition can be used for identification and surveillance on secure areas or on public places to detect illegal activities. It can also be used in government security issues like national ID cards, passports and license, etc.

Neural networks are used for face recognition and used for decision making to perform complex functions. In FFNN neurons form the layers. In the training process, the weights that connect neurons of consecutive layers are obtained using the inputs of neural network and the desired output.

II. Face Detection

Facial recognition is one of the software applications that can identify a specific individual in an image and also the ability to recognize people by their facial characteristics. Face recognition using Eigen faces is the advanced one because it maps the characteristics of a person's face into a multidimensional face space. Computers can conduct facial database searches and perform one-to-one or one to many verifications with unprecedented accuracy. Users can have secure access to their computer, mobile devices or for online ecommerce, simply by looking into their Web camera.



The computer can distinguish the same person with different appearances; for example, with or without glasses, change of hair style and seasonal skin color changes.

In the first step,we have to apply low pass filter on an image to attenuate the noise.In our system C_b,C_r (Chrominance) components because these are independent of skin colour and human face so,YC_b,C_r color space is used.In the next step Gabor filter is applied on the image to extract the features and we are using neural networks

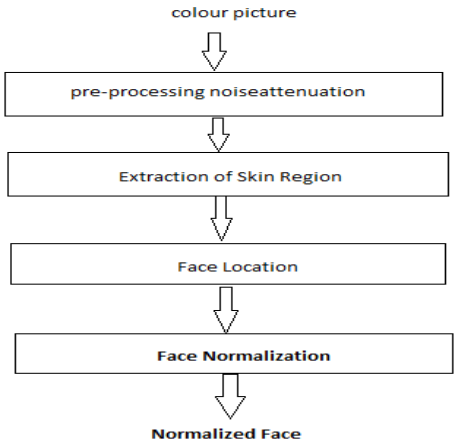


Fig: Face detecion

III. Gabor Filter For Face Recognition

In image processing, a Gabor filter is a linear filter used for edge detection. Frequency and orientation representations of Gabor filters are similar to those of the human visual system. Its impulse response is defined by a sinusoidal wave multiplied by a Gaussian function. Because of the multiplication convolution property, the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function.

Complex

$$g(x,y;\lambda,\theta,\Psi,\sigma,\gamma)=\exp(x'^2+\gamma'^2/2\sigma'^2)\exp(i(2\pi\frac{x'}{y}+\Psi)$$

Real

$$g(x,y;\lambda,\theta,\Psi,\sigma,\gamma)=\exp(x'^2+\gamma'^2/2\sigma'^2)\cos(2\pi\frac{x'}{y}+\Psi)$$

Imaginary

$$g(x,y;\lambda,\theta,\Psi,\sigma,\gamma)=\exp(x'^2+\gamma'^2/2\sigma'^2)\sin(2\pi\frac{x'}{y}+\Psi)$$

Where,

$x'=x\cos\theta+y\sin\theta$

$y'=-x\sin\theta+y\cos\theta$

In this equation,

λ is wavelength of the sinusoidal factor

θ is orientation of the normal to the parallel stripes of a Gabor function

Ψ is phase offset
σ is sigma or standard deviation of the Gaussian envelope
γ is special aspect ratio

IV. Neural Networks

A neural network is defined by a set of input neurons which may be activated by the pixels of an input image. After transformed by a function the activations of these neurons are passed to the other neurons. This process is repeated until finally, an output neuron is activated.
Neural networks have the capability to obtain meaning from imprecise data; can be used to extract and detect patterns that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be considered as an "expert" to analyze the given information.

V. Feed Forward Neural Networks

In FFNN the input is transformed to the output through the neurons in this multilayer network is available to form the layers .The input for the neurons taken from the output of the previous layer

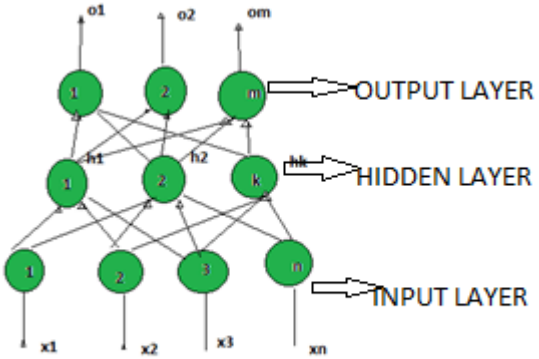
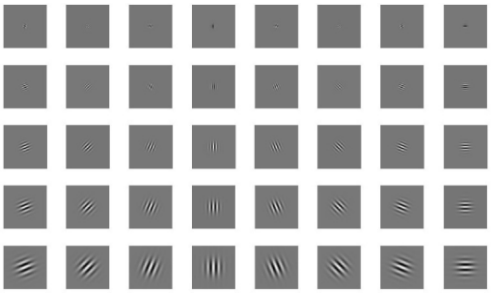


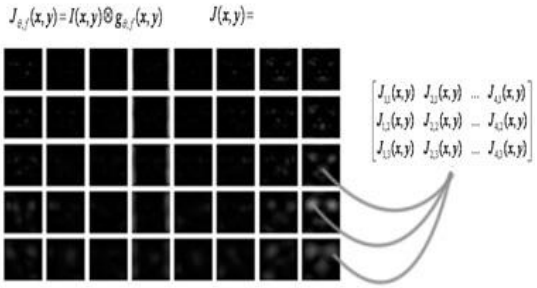
Fig: Architecture of FFNN for face classification

VI. Gabor Feature Extraction

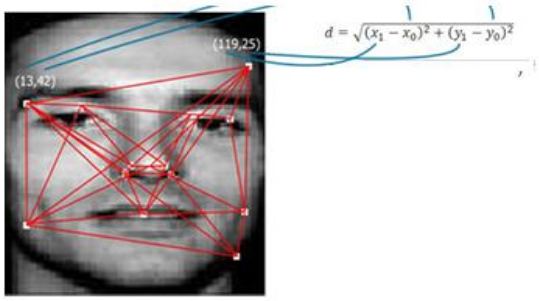
A set of Gabor filters with different frequencies and orientations may be helpful for extracting useful features from an image. In this 40 different Gabor filters are applied on an image to get accurate output.



First we have to apply the neural network on the areas of an image. This filter marks the points on an image by correlation between the faces.

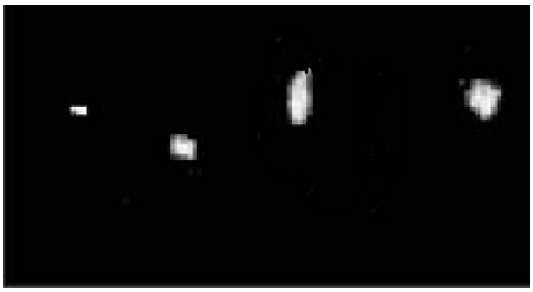


After that the distance between the points are calculated by using distance formula to reduce those points. Again the distance between the reduced points are calculated and compare with the data base to detect the human face.



VII. Experiment Results

In this system human face is detected for some images present in the given database. Here, this will be detected by using 40 different Gabor filters. Neural network also applied for the areas of an image. So, fiducial points will be marked and the distances are calculated. Comparison is done in accordance to distances.



Finding the center of each region

Final Result

By using the Gabor filters and neural networks face recognition will be accurate. We can detect any number of faces in that image but, those faces must be in the pre-defined database.

VIII. Conclusion & Future Work

Face detection is a challenging and attractive field for research. Many algorithms are introduced for automatic face detection since 1888.

Some improvements have to be made are:

- To minimize the rotation effects, we have to apply the transformation for a motion estimation stage using feature points. For recognition we have feature vectors so, there will be no computational complexity.
- If any video is given as the input to the system we have to take frontal pose of the person to improve the performance of the algorithm. This is realized by measuring the distances between main facial features which are denser points.
- If we decrease the Gabor filters to the acceptable level then the speed of the algorithm will be increased.

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