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Implementation of Gabor Filters Combined with Binary Features for Gender Recognition

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ABSTRACT

The human face is an important biometric Includes a great deal of useful information, such as gender, age, race and identity. Gender classification is very convenient for humans, but for a computer this is a challenge. Recently, gender classification from face images is of great interest. Gender detection can be useful for human-computer interaction, Such as the designation of individuals. Several algorithms have been designed for this purpose and the proportion of each of these issues has been resolved, our proposed method is based on Gabor filters and Local Binary Patterns (LBP), which extract facial features that these characteristics are robust against interference. In order to achieve an appropriate classification, we used self-organizing neural networks, in this neural network weights are extracted for each gender with little error. The results are compared with existing data sets that this comparison will prove the superiority of the proposed method.

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1. INTRODUCTION

One of the important results in image-based face recognition system is advised to determine the gender of the face image.Methods for identifying a person from the face havea variety of different algorithms. Proposed methods for face recognition, mainly based on the training process and practice of multiple images for identifying different people. As a good example of this method is that the neural network and SVM approaches [1-5]. The use of detection method based on training, requires a group of images for a single person that this process is difficult. On the other hand, from real applications such as video surveillance, cannot produce multiple images of a person. For this reason, single-imagebased face recognition techniques have become a favoriteand applicable research field [6, 7].

Gender classification is the main tasks of identification systems. Which is seen in applications such as monitoring, surveillance topics and business profile [8]. In this paper, a novel method is proposed for estimating gender, which is a method for extracting features based on a binary image using the rotating patterns of self-organizing neural network weights. In the proposed method, the public face of both genders which is obtained by taking the average of the input images of men and women is used to compare and then local apparent difference is found. To increase the gender classification accuracy, the proposed method uses Gabor and LBP feature and face classification based on triangular method, which can help to extract the maximum meaningful radius of face image. In fact the meaningful radius of the face image is distinguished features of each case. After extracting Gabor and binary feature, according to the difference between the public figure of each gender, we proceed to cluster them. The clustering is performed based on self-

organizing neural network, and in the final stage of the proposed method, based on images position in the Clusters, gender is determined.

In the second section of this paper, we review on thelast works of the field of gender classification. The third section is a review on general structure of the face, the fourth section proposed our method. Practical results are presented in the fifth section of the paper and the last section is a conclusion of the paper.

2. RELATED WORKS

Until now various techniques have been proposed for gender classification, that this technique uses different methods for extracting features from the images and then separate them. In general, these methods can be divided into approaches listed below:

2.1. The Appearance-Based Approaches

The first set of face image features extraction approaches is appearing based approaches. This extracts the general information of each person's face from facial features. In this method, rows or the columns of data related to the image first puts together. And then from the Dimensionality Reduction statistical techniques such as PCA, LDA, ICA used for dimension reduction and data resolution [9-13].

2.2. The Geometric Features-Based Approaches

In this approach, a face image is divided into different areas face components, such as the eyes, mouth, nose, etc. And geometrical features of the each face component such as nose length, distance between the eyes and other facial features are extracted. Actually in this Method, the shape and position of facial parts, such as mouth, eyes, eyebrows and nose are identified. And feature vectors of all parts of the face are extracted [8].

2.3. The Model-Based Approaches

In model-based approaches, Base model uses the information from the different components of the face.Actually in this Methods, Goal is constructing a model ofthe human face, based on the changing the face and its features. This model is able to detect the face changes. Among this method we can mention Elastic Bunch Graph (EBG) and an Active Appearance Model (AAM) [14].

2.4. The Hybrid Approaches

In this approach weuse a combination of two or more of the approaches discussed above are used [15]. With these methods we combined variety of different approaches. Actually these techniques looking for improved methods of combining them. Combining existing techniques may overcome the shortcomings of the existing methods.

3. STRUCTURE OF GENERAL FACE IMAGE

Due to lack of training process in the proposed method, we apply a single general image for each gender for determination of the gender of the input image. General image is obtained with a linear combination of the single gender images. Figure 1 is an example of the general images. That respectively figures (1-a) shows the general image obtained from the AR image database and figure 1-b shows the general image from the other image database.

Figure 1. A sample of the general images of men and women

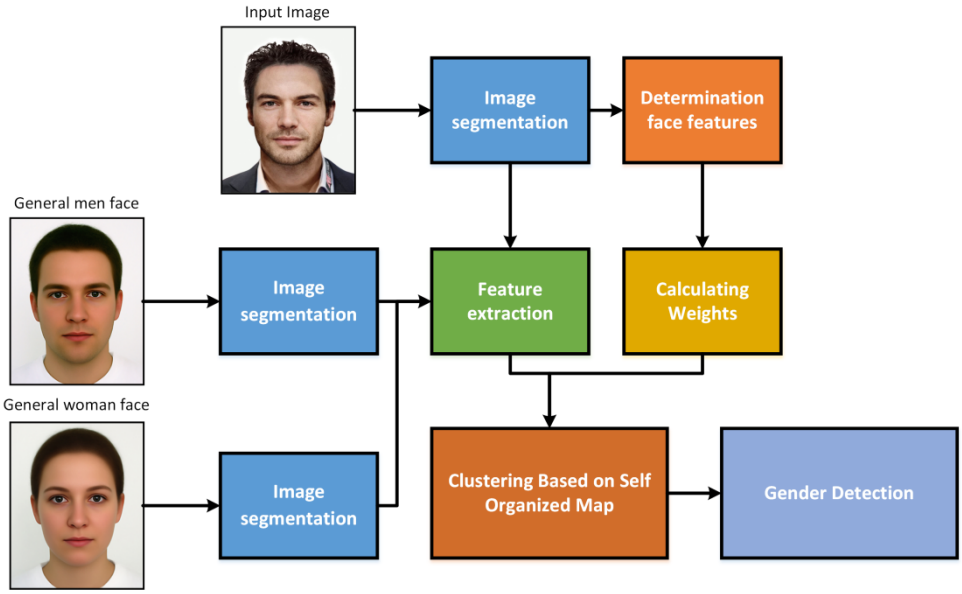


Figure 2. Block diagram of the proposed gender classification system using face images

4. PROPOSED METHOD

The proposed method is based on applying a single figure for each. A feature extraction method based on Gabor filter and local binary pattern, and classification is done based on self-organizing neural network, In this method, self-organizing network has 50 hidden layers which are 64 * 64 pixels image dimensions accepted as input. Gender classification system block diagram is shown in Figure (2). In this block diagram, Stages of gender detection are doneby segmenting images with each gender. Segmentation performed with the use of the triangular segmentation technique [16]. After segmentation, feature of all parts of the picture is extracted, after extracting features, these features are clustered. By using the rest of Clustering stage can detect the gender of the input image with acceptable accuracy.

4.1. Image Segmentation

After an overview of the proposed method, first work for gender Detection is the segmentation of input image about each gender. Image segmentation is done by triangular segmentation that leads discriminative feature about each gender is extracted. Based on figure (3) every image of AR database, divided into eight parts that with original image this part is nine. These parts in fact are the section that features must be extracted.

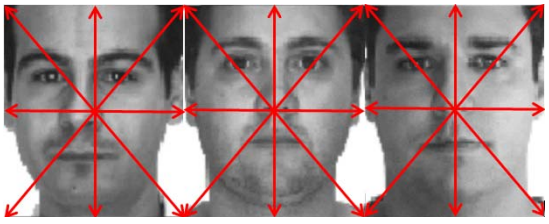


Figure 3. Triangular segmentation of input image into 9 main parts

4.2. Determination Face Features

Segmentation stages of the image lead to 9 parts of face image. The points that come after image segmentation which is all features of face image haven't same important in the gender classification. To determine the important features of the face, the input image is filtered using Sobel and Log operators. The output images have different information that is obtained by combining wavelet. Features of the face such as eyes and mouth are important for gender classification, which is bold in that picture. Figure (4) shows the detection of facial features [17, 18].

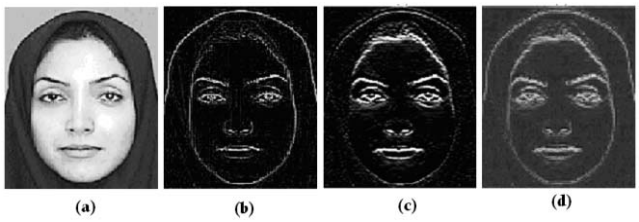


Figure 4. Face feature detection. (a) Input image, (b) Apply operator Log,
(c) Apply operator Sobel, (d) Composition operator Log and Sobel

4.3. Feature Extraction

After segmentation the face image and determining characteristic of input images, features of the facial image is extracted. Extraction of facial features is known as the most important part of the process of gender recognition. Sections presented in this paper, describes the main steps in the proposed method to extract the features.

4.3.1. Apply Gabor Filters

Facial feature extracted from the image by applying Gabor coefficients on each area of the face is done. This area of the faceis created according to the triangular classification of faces as shown in (3). Logarithmic Gabor wavelet is one of the most effective methods known in the regionalization of the tissue. So that it can be easily separated information about tissue from the middle frequency bands and used in segmentation algorithms. Because feature extraction for face recognition using Gabor filters, leads to good results, here are Gabor filter based feature extraction techniques is employed. Equation 1shows the Gabor filters.

$$\left\{ \qquad (1)$$

Where x and is special indexes and σ, λ, γ, Ø, m are the wavelet parameters. To extract the features of the images, a set of Gabor filters with 5 spatial frequency and 8 different angles are used that create 40 Gabor filters in different poses. This process in Figure (5) is shown. This feature applies on the face images in the special places.

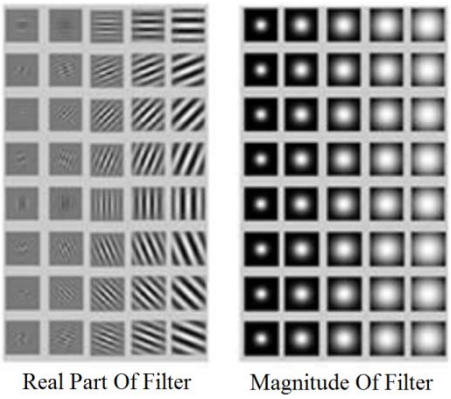
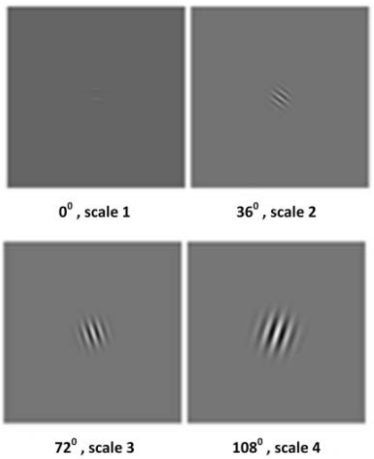


Figure 5. Gabor filters with 5 spatial frequency and 8 different angles

For the input image in the figure (6-a) result after applying Gabor filter with different rotation angle (figure 6-b) is shown in the figure (6-c) that this image results output image. As shown in Figure (6-c) can be

seen. This shape shows a good example of face and facial shapes that can be picked up different textures at different angles and can be extracted the location of the eyes, mouth and forehead. The proposed method in this paper, for extraction the weights related to each face image uses a general average of Gabor filter about any individual.

(a)



(b)

(c)

Figure 6. (a) Input image. (b) Gabor filter with rotation angle = 0^o, 36^o, 72^o, 108^o. (c) Output image after applying Gabor filter with different angels

4.3.2. Local Binary pattern:

LBP operator with a threshold of 3 × 3 neighborhoods in each pixel, labels to the pixels of an image and makes a binary number will result. The LBP features are used frequently to classify gender of face images [17, 19].

$$S(f_p - f_c) = \begin{cases} 1 & f_p \geq f_c \\ 0 & f_p < f \end{cases} \quad (2)$$

$$BP(f_c) = \sum_{p=0}^{7} S(f_p - f_c) 2^p \quad (3)$$

Where in the equation 2 and 3, f_c is the value of the central pixel and f_p is the neighborhood of the central pixel. The value of the LBP calculates with equation (3). $LBP_{P,R}^{u}$ Is used for uniform LBP operator [19]. Use of LBP operator in the neighborhood points P on the circle with radius R is sampled. Figure (7) shows the LBP operator for the neighborhood 3 and figure (8) shows LBP results for P = 8, R = 1.

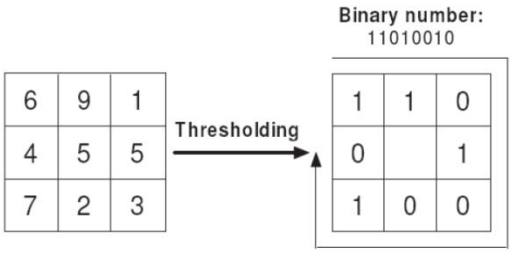


Figure 7. Use of LBP operator in neighborhood (1, 8)

4.4. Self-Organizing Map Learning Algorithm

Self-organizing Map (SOM) is an unsupervised Learning algorithm. Basically unsupervised learning algorithms can define by the first order equations. These equations describe how the weights of the network are compatible over time and repeated discrete state. In order to compatibility the weights, often used asimilarityscale or pattern association model to guide the learning process that usually leads us to the forms of correlation, clustering and competitive behavior of networking. SOM learning algorithm, in general based on choosing the winner neuron and moving that neuron and some of its neighbors to the desired information. We can summarize the SOM in following steps.

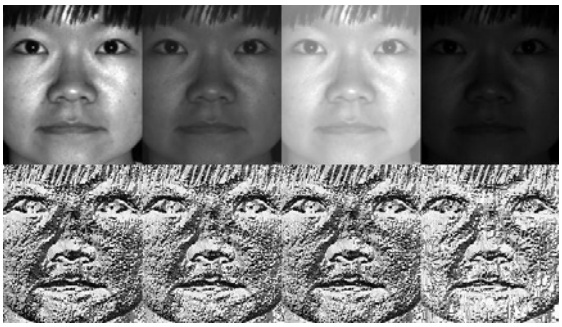


Figure 8. Appling LBP on the various face pictures

4.4.1. Initial State

In this stage, the weight of each neuron created based on the previous weights that extracted from the nonlinear features. In this paper, weights adjust based on Separation low level Features also extraction Gabor features and binary feature and an input pattern from the public figures is applied to the network.

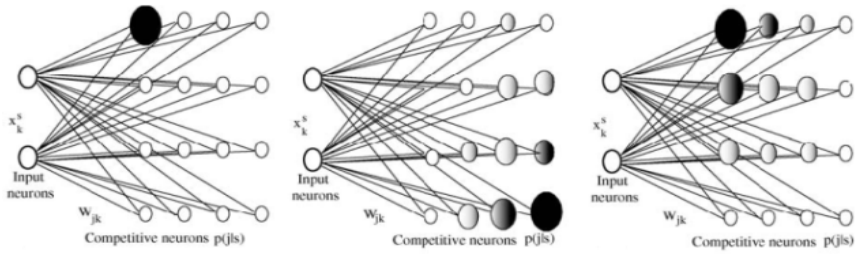


Figure 9. Winning neuron is selected from the reference patterns in self-organizing neural network

4.4.2. Select Winner Neuron

In this stage based on a similarity measure of the network, winner neuron is selected. Different similarity measures can be implementedin self-organizing maps, but these networks are most commonly used Euclidean distance. This is calculated by equation 4. The input is compared with all the elements in the

network. Winning neuron is the neurons with a minimum distance between the reference inputs of all patterns.

$$\|X - W\| = \left(\sum_{i=1}^{d}(X_i - w_i)^2\right)^{\frac{1}{2}} \quad (4)$$

$$\|X - m_c\| = \min_i\{\|X - m_r\|\} \quad (5)$$

Where m_c winner neuron and m_r is the reference vectors. Figure 9 show selection of winner neuron from reference vectors. Winner neurons identify figures with same content and set neighbor neurons to achieve better results.

4.4.3. Set the Neighbor Neurons

After finding the winning neuron, a set of neurons is determined in the neighborhood of the winning neuron should change their values. In general, a changes value of neighboring neurons is done in two ways: In the first case a certain radius of the neighborhood around the winner cells is selected. In this way, all the neurons of the network are at a certain distance from the winning neuron will move with a constant factor towards the input. In the second method, all existing neurons in the network moves towards the input with an unequalfactor. This unequal factor is in a form that winner neuron has maximum value and with separation from the winner neuron, its value is decreasing [1].

4.4.4. Weights Update

After determining the neighboring neuron, finally must weight related to the winner neurons and its neighbors based on the network is improved, this improvement done by equation 6.

$$m_r(t+1) = m_r(t) + \alpha(t).h_{cr}(t)[x(t) - m_r(t)] \quad (6)$$

Where x is the input vector in time t, m_r is rth reference vector at time t, α learning rate at time t andh_{cr}Are neighbor functions that calculating based on kernel function in the equation 7.

$$h_{cr}(t) = \exp\left(-\frac{\|k_c - k_r\|^2}{2\sigma(t)^2}\right) \quad (7)$$

In this equation k_c is the winner neuron and *Kr is* a reference pattern of its neighbor and σ is radius of kernel functions in time *t.* Result of the above modification of weights and moving neurons towards the training sample. In general unsupervised learning is so complex from the supervised learning. And therefore needs more time to learn the training patterns.

4.5. Clustering and Gender Detection

After segmentation input image to separate parts and extraction features with Gabor filters using LBP and determining the weight of test images now time to clustering that this work done by the SOM neural network. When clustering performed on the test images, depends on the place f the image gender of images identifying.

5. EXPERMENTAL FRESULTS

To evaluate the proposed method, the results of the proposed method compared with Mozaffari [20] and are shown in Table 1. For the proposed method we use the AR face image data base contain 126 people, 56 women and 70 men face images [21].

Table 1. Result of detection rate (%) of proposed method compared with Mozaffari approach

Approach	Detection Rate		Overall percentage
	Men	Women	
Proposed Method	**91.67**	**89.001**	**90.3355**
Mozaffari [20]	80.9	86.50	83.7

6. CONCLUSION

Face recognition is one of the interests in fields such as image processing, identification schemes, video surveillance systems, and etc. Gender detection is one of the branches of face detection. Most existing methods in the field of Gender detection based on a database of images that has training and testing process. The proposed method is based on using a single image per person, recognition of the gender done by extraction features based on Gabor filters andlocal binary patterns that features extracted from parts of picture that create by triangular segmentation technique and clustering of this feature done by the SOM neural network. After clustering we can determine the gender of input image.

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