Back Propagation Neural Network Based Gender Classification Technique Based on Facial Features

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Abstract

The gender recognition system with large sets of training sets for personal identification normally attains good accuracy. The features set is applied to three different applications: Pre-processing, Feature Extraction and Classification. The gender are classified on the basis of distance between eyebrow to eye, eyebrow to nose top, nose top to mouth, eye to mouth, left eye to right eye, width of nose, width of mouth. First to extract these features by using Viola Jones algorithm and then apply Artificial Neural Network. The features set is applied to three different applications: face recognition, facial expressions recognition and gender classification. In this paper described two phases such as feature extraction phase and classification phase. The proposed system produced very promising recognition rates for our applications with same set of features and classifiers.

Keywords:

Feature Extraction, Gender Classification, Back Propagation neural network.

1. Introduction

A problem of personal verification and identification is an actively growing area of research. Face, voice, lip movements, hand geometry, iris, retina, fingerprint are the most commonly used authentication methods. All of these behavioral characteristics of a person are called biometrics. The driving force of the progress in this field is due to the growing role of the Internet and electronic transfers in modern society. Therefore, considerable number of applications is concentrated in the area of electronic commerce and electronic banking systems. The biometrics have a significant advantage over traditional authentication techniques due to the biometric characteristics of the individual are not easily transferable, are unique of every person and cannot be lost or broken. The biometrics is a behavioral characteristic used in personal identification and verification and the choice of the biometric solutions depends on user acceptance, level of security, accuracy, and cost and implementation time. Gender classification is one of the biometrics methods to identify individuals by the features of the face. The gender of a person is categorized by visual observation of images whereas it is difficult in the computer vision. The gender is classified by determining the distance of eye, nose, mouth etc.

Gender plays a significant role in our interactions in society and with computers. Actually Gender classification is a binary classification problem in which one has to predict an image belongs to a man or woman. It is an easy job for a person but a challenging one for computers.[1] There are many advantages of facial metrology.(i)Memory Management: compared to texture-based information in face images require much less storage space. (ii) Information Privacy: unlike the full face image information can be safely stored. (iii) Prediction of Missing Information: face coordinates can be either global or local to specific facial regions. Thus, missing information can be approximately predicted. In this present scenario, image plays vital role in every aspect of business such as business images, satellite images, medical images and so on. The features further can be classified as low-level and high-level features. Features extraction deals with extracting features that are basic for differentiating one class of object from another. First, the fast and accurate facial features extraction algorithm is developed. The training positions of the specific face region are applied. Facial feature extraction system has been described, which combines good accuracy of feature extraction and gender classification.[3]

In the last several years, various feature extraction and pattern classification methods have been developed for gender classification. Moghaddam and Yang [8] introduced the best gender recognition algorithm in terms of classification rate. They adopted an appearance-based approach with a classifier based on a Support Vector Machine with Radial Basis Function Kernel (SVM+RBF)[8].

A novel model for face detection and gender identification based on logistic regression. We allow the Gabor filter features to be selected arbitrarily in a large feature set. In this way, the features selection can be more discriminative, and hence our approach is more accurate for gender identification. Our approach is able to handle a wide range of variations in static color images, based on a lighting compensation technique and a nonlinear color transformation. The gender is identified from color images

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using logistic regression. In that method, first to detect the face, after detecting the face to extract the feature from face then to generate the face vector and at last to apply the logistic regression method.[1]

Many different technique for solving the problem of gender identification from facial features. These technique includes support vector machine, geometric features based method, graph matching method and neural network based method. In any feature based classification model the first step is feature extraction. Many algorithm have been proposed to locate faces in an image and extract facial features from facial images. Yang and Huang [2] have proposed a hierarchical knowledge based method for detecting human faces in complex background. Shackleton and Welsh [3] have proposed a template matching based method to locate facial features such as eyes accurately. Wu and Yokoyama [4] have used color information (skin and hair) to locate and detect facial features in human faces. In order to extract the contour-line of face features a multiple active contour model has been used with color information based energy terms. Kawaguchi and Hidaka [5] have used circular Hough transformation to locate eyes in human faces. Eveno, Caplier and Coulon [6] have presented a method for identifying exact lips shape from localized colored image of lips.

2. Previous Work

Face detection and gender identification method is described in fig 1.

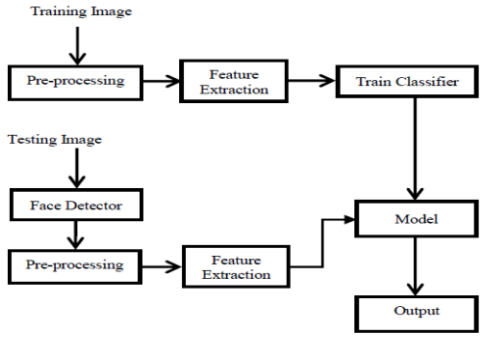


Fig 1: General approach for gender identification system

2.1 Face Detection

The approach on this paper will use mainly the color based algorithm with the technique of color space transformation from RGB (red, green and blue) to YCbCr (luminance, chrominance blue and red). The proposed method first detects the face region using skin-color from image. The given input RGB image is converted into the YCbCr color space.

2.2 Preprocessing

The problem of elimination of non-standard illumination is one of the most complicated problems in the area of computer vision, due to the complex illuminated environment in the real world. In face detection and gender recognition problems, non-standard illumination effects become severe. The accuracy on detecting skin color in complex background is difficult to increase. It is because the appearance of skin-tone color depends on lighting condition.

2.3 Feature Extraction

Face extraction is not a difficult task for human beings. The Gabor filters is used for extracting the features. A 2D form of Gabor wavelet [7] consists of a planer sinusoid multiplied by a two dimensional Gaussian is used for image processing. 2D Gabor wavelet highlights and extracts features from an image.

2.4 Feature Vector Generation

There are different ways to form the feature vector for training the classifier. Some of them even use whole image as a feature vector and perform identification which needs high computation. So here feature vector is made from important values of the image from each filter Energy, mean and standard deviation forming a 40 value feature vector for every image. Feature vectors are generated at the feature points as a composition of Gabor Wavelet transform coefficients.

2.5 Logistic Regression

In this paper, we use a classifier based on logistic regression that, (i) Has a well defined cost function (ii) Can form non-linear combinations of several filters to capture variation of the target key point.

3. Proposed Work

Complete algorithm can be divided in four categories.

A. Face Detection

B. Feature Extraction
C. Back Propagation Neural Network
D. Gender Classification

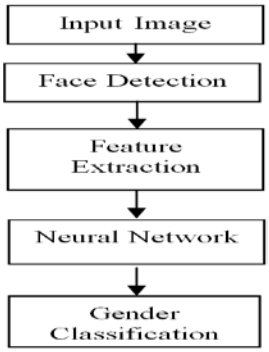


Fig:2. Fundamental Steps in Gender Classification

3.1 Face Detection

Face Detection is one of the most important tasks of any facial classification system. The face are detected by using Viola Joans Algorithm. In Viola-Jones algorithm, first to scan a sub-window capable of detecting faces from a given input image. And then to rescale the input image to different sizes and at last to run the fixed size detector through these images. This approach turns out to be a time consuming due to the calculation of the different size images. Contrary to the standard approach Viola-Jones rescale the detector instead of the input image and run the detector many times through the image each time with a different size. At first one might suspect both approaches to be equally time consuming, but Viola-Jones have a scale invariant detector that requires the same number of calculations whatever the size.

3.2 Feature Extraction

Viola Jones Algorithm is used for the feature extraction. The Leonardo Da Vinci principal is used for determining the geometry of the faces. The distance between eyebrow to eye, eyebrow to nose top, nose top to mouth, eye to mouth, left eye to right eye, width of nose, width of mouth, these features are selected from the images.

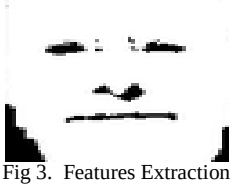


Fig 3. Features Extraction

3.3 Artificial Neural Networks (ANN)

Neural network have received much attention for their successful application in pattern recognition. Once a neural network has been configured, it forms an appropriate internal feature extractors and classifiers based on training examples. Neural networks consist of a set of interconnected neurons which operates together to perform a particular task. Each neuron is associated with its weight. In training phase, network uses training set to update weights of its neuron in order to reduce network error. After the training phase, trained network is used for classification. The representation internally distributed across the network as a series of independent weights has many advantages: noise immunity, pattern generalization and interpolation capability.

An ANN is created by combining artificial neurons into a structure containing three layers.

1. The first layer consists of neurons that are responsible for a face image sample.
2. The second layer is a hidden layer which allows an ANN to perform the error reduction necessary to successfully achieve the desired output.
3. The final layer is the output layer wherein the number of neurons in this layer is determined by the size of the set of desired outputs, with each possible output being represented by a separate neuron.

3.3.1 Back propagation Networks (BPN)

Back propagation neural networks are the most common neural network structures, as they are simple, effective and useful in variety of applications. Back propagation neural network is a network of nodes arranged in layers. First layer of network is input layer, last layer of the network is output layer and remaining all intermediate layers are hidden layers. Three layered back propagation neural network having input, output and hidden layer, has been used for classification. All nodes from one layer are connected to all nodes in next layer. Each connection is associated with its weight which represents strength of the particular connection. Before the training process, the weight for the nodes are considered as random.

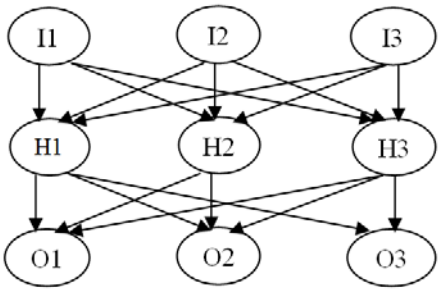


Fig 4. The structure of a back propagation network

3.3.2 Training Process

Any network must be trained in order to perform a particular task. In training process, training data set is presented to the network and network's weights are updated in order to minimize errors in the output of the network. Back propagation neural network uses back propagation algorithm for training the network. The principal advantages of Back propagation are simplicity and reasonable speed.

The training of ANN is carried out in two parts.

1) The feed-forward path is trained using the standard back propagation algorithm, until the feed-forward path is trained. The feedback path must be taught to produce different signals depending on the initial output from the feed-forward algorithm. The feedback signals will vary depending on the stability of the sample input.
2) The training of the feedback path is conducted using a set of pairs consist of two face images. The use of these pairs facilitates the adjustment of the weights in the feedback path. The training phase is complete as soon as the feed-forward and feedback paths both have been trained.

3.4 Gender Classification

The gender are classified on the basis of distance between eyebrow to eye, eyebrow to nose top, nose top to mouth, eye to mouth, left eye to right eye, width of nose, width of mouth.

Artificial Neural Network is used for classifying the gender. First step in any classification technique is the representation of face in terms of input vector. Once all facial features are extracted, a classifier has been trained which can classify input vector as a male or female. In present work, Neural Network have been used for this purpose. This selection presents the design of neural network used in classification and finally design of final classifier consisting of neural network has been proposed.

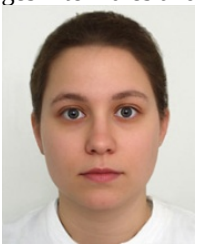
4. Experimental Result

The gender is classified on the basis of distance between eye brow to eye, eyebrow to nose top, nose top to mouth, eye to mouth, left eye to right eye, width of nose, width of mouth by using the Artificial Neural Network. The features are extracted by using Viola Jones Algorithm and Leonardo Da Vinci principal is used for geometry of faces. We use a fast and reliable method that is capable of classifying genders based on a simple feature extraction. The efficiency of the proposed method makes it a good choice for real-time systems. The database was created by taking 100 images of males and females from CIPM institute. In the database there were some images of males appearing as a females and females appearing as males, this method successfully classified all the images into males and females.

4.1 Data Set

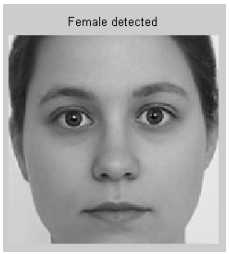
Males: 100 images
Females: 100 images

The database was created by taking 100 images of males and females from CIPM institute. In the database there were some images of males appearing as a females and females appearing as males, this method successfully classified all the images into males and females.



Input Face
(Face Detection)

Extracted Features



Output Face
(Gender Classification)

4.2 Neural Network

The Back Propagation Neural Network is used for classifying the gender. There are seven input such as distance from eyebrow to eye (D1), distance from eye to nose (D2), distance from nose to mouth (D3), distance from eye to mouth (D4), distance from left eye to right eye (D5), width of nose (D6), width of mouth (D7), four hidden layers and one output such as male or female. The network architecture is described below.

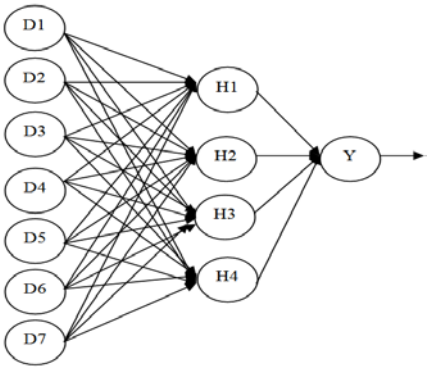


Fig:5 Architecture of Neural Network

4.3 Final Result

Table 1: Features Distances For All Female Images

Sr. No	D1	D2	D3	D4	D5	D6	D7
1	28.0	99.0	43.0	114.0	35.50	8.70	30.80
2	18.0	62.0	26.0	70.0	22	5.70	18.90
3	29.0	102.0	44.0	117.0	36	9.0	31.50
4	26.0	89.0	38.0	101.0	32	7.80	27.30
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100	23.0	79.0	34.0	90.0	28.50	6.90	24.50

Table 2: Features Distances For All Male Images

Sr. No.	D1	D2	D3	D4	D5	D6	D7
1	27.0	93.0	40.0	106.0	33.50	8.10	28.70
2	27.0	95.0	41.0	109.0	34.0	8.40	29.40
3	24.0	82.0	35.0	93.0	29.50	7.20	25.20
4	25.0	86.0	37.0	98.0	31.0	7.50	25.20
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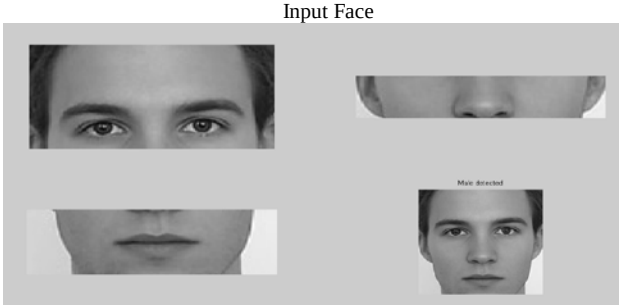
100	26.0	90.0	39.0	103.0	32.50	7.80	25.0

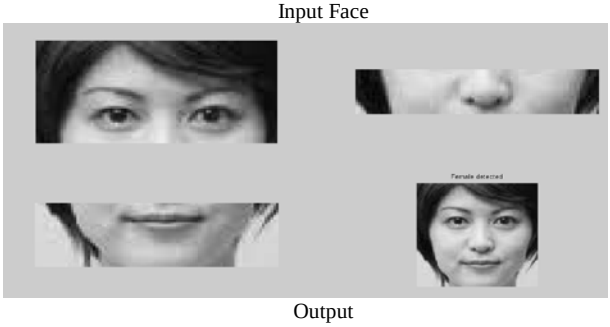
D1: Distance from eyebrow to eyes.
D2:Distance from eyes to nose.
D3: Distance from nose to mouth.
D4: Distance from eyes to mouth.
D5: Distance from left eye to right eye.
D6: Width of nose.
D7: Width of mouth.

Input Face



Output

Input Face



Output

Fig:6 Final Result

5. Conclusion

A fast and efficient gender classification system based on facial features has been developed to classify the images on the bases of gender. The proposed methodology give 100% accurate results in identifying male and female images. This paper presents the results with hundred male and hundred female images. The proposed system has a low complexity and is suitable for real time implementations.

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