

Gender Classification Using Facial Features

Dhanashri P. Lale, Kailash.J.Karande

Abstract— Image processing is a field in which biometric traits such as Face, voice, lip movements, hand geometry, odor, gait, iris, retina, fingerprint etc. are important for recognition. Face is the most important biometric trait for recognition because face is easily approachable biometric trait there is no need of attention from human being for face recognition. Human face classification is the challenging task for machine. In this project minimum distance classifier is used with Principal Component Analysis based gender classification. Database of 100 images (50 male and 50 female face images) is used for the face recognition and classification. Original face image database is used for the gender classification. It is observed that gender classification accuracy of our project is 97%. The proposed paper is nothing but sequential steps of gender classification system.

Index Term- Facial feature extraction, Principal component Analysis (PCA)

I. INTRODUCTION

The most expressive part of human body is face. Using facial images for gender classification has become interesting area of research now a days. Because human face provides important information regarding gender, age, race and identity etc.[1][12]. The gender classification is the part of face recognition. Face recognition is the biometric technique for verifying and recognizing faces. Gender classification is still a challenging task. The main steps of gender classification are preprocessing, feature extraction and classification. The important visual tasks for human beings is gender classification such as many social interactions highly depends on the correct gender classification. As many applications uses, computer vision systems for gender classification will play an most important role in our lives.

The main objective of gender classification is to reduce the search space. The reduced search space reduces the search time of identification. There are many techniques for face recognition such as Principal Component Analysis, Linear Discriminant Analysis, Incremental Component Analysis, these are the linear techniques for face face recognition. Kernel Principal Component Analysis and IsoMap are non linear techniques[17]. The classification of Biometric traits are behavioral and physical traits. Behavioral biometrics are signature and typing rhythms. Physical biometric systems are the iris, finger, palm, voice and face for identification. 3D faces are also used for Gender classification. The features such as range and intensity are used for gender classification[10].

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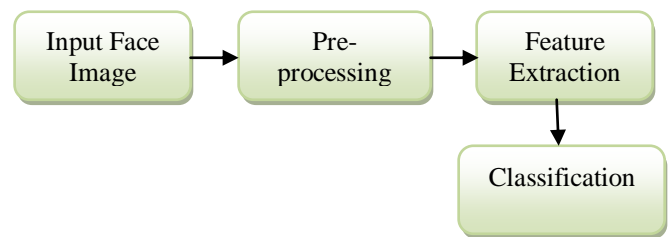


Fig.1 General Classification Steps

A. Preprocessing:

Some preprocessing is required for every face database. Preprocessing such as noise or redundancy removal, colour conversion, histogram equalization, normalize the light illumination, edge detection etc.

B. Feature Extraction:

The result will be very slow when working directly on an image because original image contains thousands of pixels. But all these pixels will not be used for classification therefore feature extraction is used. Samarasena Buchala et.al. [11] Implemented Global and Feature based Gender Classification of Faces. The experiment was done by using PCA, CCA and SOM. These algorithms were applied to different face parts like eyes, mouth and full face image. The PCA gives 87.5% result than other methods. There are two methods of feature extraction.

1. Geometric based feature extraction:

Geometric based feature extraction is based on distance between facial points such as eyes, nose, mouth, chin. Swathi Kalam and Geetha Guttikonda[18] reported 95.6% accuracy rate after calculating the the ratios of left_eye to right_eye distance, eye to nose, eye to lip and eye to chin distance for feature extraction.

2. Appearance-based Feature Extraction:

Appearance-based Feature Extraction based on the feature extraction of whole face parts. Ziyi Xu et.al.[15] experiment on geometric and appearance based features are fused together and then classification takes place. A Hybrid to Gender Classification from Face Images.

C. Classification:

After feature extraction classification takes place in which step faces are classified as male or female successfully[9]. Classifiers are used extracted features for classification.

II. LITERATURE REVIEW

In 2005, Jain et.al [1] presented an approach using ICA and SVM. The experiment was done with different classifiers namely cosine classifier which find distance between two features lying on a hyper-sphere surface, linear discriminant classifiers that finds the projection of the input image maximizing the ratio between class scatter and within class scatter, and SVM which finds the maximal separating hyper plane between male and female features. The experiment was performed on 500 images from the FERET

facial database which included 250 images of female and 250 images of male, and obtained an accuracy of 96% in ICA space.

Erno Makinen and Roope Raisamo [2] experimented on gender classification with automatically detected and aligned faces. The experiment was performed on IMM database and FERET database with four automatic alignment methods and four different gender classification methods. In Automatic alignment methods, three methods were based on Active Appearance Model and one based on profile alignment. The four Gender classification methods were used. The automatic face alignment methods did not increase the classification rate where as manual alignment increased the classification rate. The classification accuracy was dependent on face image resizing before or after alignment. The best classification rate was obtained with SVM using pixel based input images of size 36×36 .

Tejas et.al [3] experimented the gender recognition problem with discriminant functions which include PCA, LDA and SDA on a heterogeneous data base of 8112 images that included variations in illumination, expression, minor pose and ethnicity. The result showed that PCA provides better performance than PCA+LDA, PCA+SDA, and PCA+SVM. The result showed that linear discriminant functions provide good generalization capability with limited of training samples.

Method proposed by Samarasena Buchala et.al. [4] PCA encodes face image properties such as gender, ethnicity, age, and identity efficiently – the classification performances on all properties are reasonably high and much above chance levels. Different components of PCA encode different properties of faces. Very few components are required to encode properties such as gender, ethnicity and age and these components are predominantly amongst the first few components which capture large part of the variance of the data.

F. Saei Manesh, M. Ghahramani, Y. P. Tan [5] experimented “Facial Part Displacement Effect on Template-based Gender and Ethnicity Classification”. The gender and ethnicity recognition, by using automatically separated face regions using the modified Golden ratio mask. Facial parts are preprocessed with multiple base point photometric normalization to prevent facial parts displacement in the noted mask, due to different facial parts’ distances of people. SVM is employed as the classifier on the extracted Gabor features of each patch to get its confidence level. The final classification results are obtained based on the output of each patch decision using the optimum decision making rule. Finally, using the most accurate normalization approach for each patch, 94% and 98% for gender and ethnicity respectively on a dataset composed of FERET and PEAL frontal face images.

Gutta et al.[6] proposed a hybrid classifier based on RBF networks and inductive decision trees for classification of gender and ethnic origin, using a 64×72 image resolution. The achieved an average accuracy rate of 92% for the ethnic classification part of the task.

Xiaoguang Lu et.al.[10] proposed “Multimodal Facial Gender and Ethnicity Identification”. A mixture of two frontal 3D face databases is used for evaluating the proposed schemes. 10-fold cross-validation was used for

ethnicity identification they used 9 folds as training set and remaining set as test set For both ethnicity and gender identifications, the experimental results show that 3D (range) information provides competitive results to the 2D (intensity) modality. It is demonstrated that the integration of range and intensity outperforms each individual modality. Experimental results demonstrate that the range modality provides effective capability for gender and ethnicity identifications. It also showed that the proposed combination strategy obtain better classification accuracy than the classifiers based on each individual modality.

M. Nazir et.al [13] implemented Discrete Cosine Transformation (DCT) technique for feature extraction and sorting the features with high variance. The KNN classifier using Euclidean distance to find closest neighbours. The different preprocessing techniques was used such as face detection. For face detection Viola and Jones method was used. Histogram equalization technique was used to stretch the contrast of the image and also used to overcome illumination variation in the image. These sorted coefficients are arranged in a vector and passed to the KNN classifier. The ratio of training and testing image is 50 to 50 for KNN classifier. Then the obtainable accuracy is 99.3%.

III. GENDER CLASSIFICATION SYSTEM

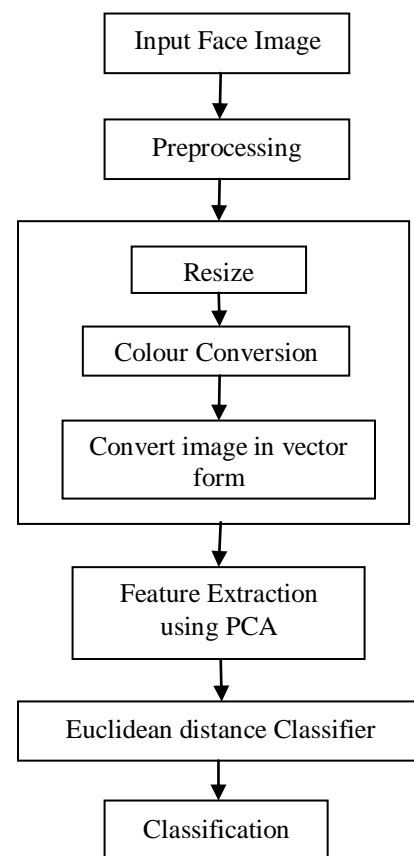


Fig.2 Gender classification using PCA

A. Preprocessing

Some basic Pre-processing steps are involved in this experiment are.

Resizing : An RGB colour image contains red, green and blue component therefore image has $M \times N \times 3$ array of colour pixels. Resizing returns that has the number of rows and columns specified by $256 \times 256 \times 3$. To preserve the image

aspect ratio imresize computes the number of rows or columns automatically.

Color Conversion : For easy processing of face image an three dimensional RGB image is converted into two dimensional gray scale image.

Converting the image in vector form: A column vector is generated for the grayscale image or for each individual plane in the new color space for scanning of image.



Fig. 3 Preprocessing Steps

B. Feature Extraction

Principal Component Analysis(PCA) is used for the extracting features for classification. PCA is unsupervised technique for dimension reduction and used to reduce high dimensional space into lower dimensional feature vector space[8]. PCA is the unsupervised technique for dimension reduction. PCA also used for data compression, redundancy removal for feature extraction. For applying PCA to the images. For face recognition and classification eigenfaces are important.



Fig. 4 Eigenfaces

C. Classification

This section described gender classification step. Minimum distance classifier used for the matching and classification purpose. The minimum distance classifier mostly used Euclidean distance classifier. Distance examines square root of difference between the coordinate of a pair of object. In geometric based classification the ratio of distance between different points are calculated and from that threshold value decided for male and female. And classification takes place. Different classification methods are used such as Support Vector Machine, KNN(K Nearest Neighbor) classifier, Different classifiers are used together for increase the efficiency of the classification. These classifiers are called as Ensemble Classifiers. The proposed system uses Euclidean distance classifier for gender classification.

D. Classification Steps of proposed system:

The image is first represented as a vector. By joining serially the columns of training set images the matrix is formed.

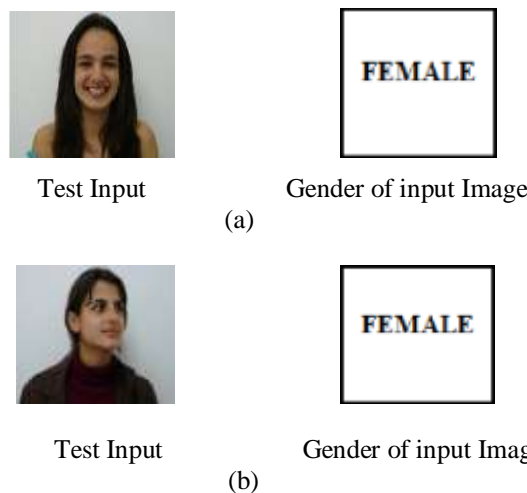
1. Then calculate the mean of the all face images Avgf.
2. subtract this mean image from all training images.
3. Convert the all difference images into single images.
4. Calculate the Eigenvalues and Eigenimages of the vector A by using single value decomposition(SVD).
5. Calculate the weight vector of each image. Then calculate weight the mean weight for single class of image.
6. Then image to be recognized is given as input image.
7. Weight of the input image is calculate. This weight of input image is subtracted from mean of every image class.
8. By using the weight vector we can find the minimum distance of training images.
9. Then find minimum distance weight vector of input image.
10. By using minimum distance classifier the image is classify.

IV. EXPERIMENTAL RESULTS

The FEI face database of 100 people (50 male and 50 female) is used to evaluate the performance of proposed system.



Fig. 5 A sample face image database



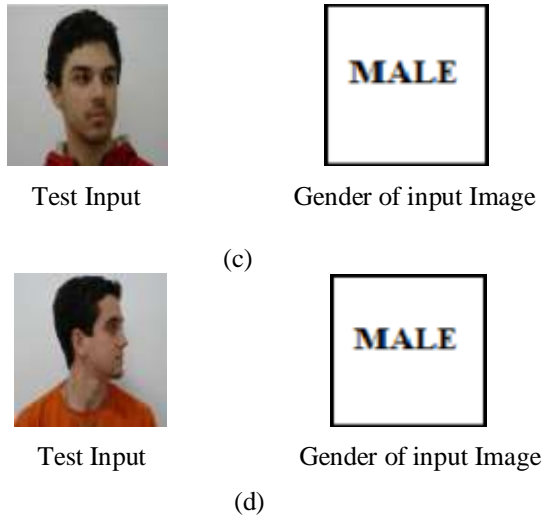


Fig.6 Gender classification of input images

The performance of proposed method in tabular form in Table I

Classification Methods	Number of correctly Classified Images			
	Male (Out of 50)	Female (Out of 50)	Total (out of 100)	% Accuray
PCA+ Minimum Distance Classifier	47	50	97	97%

Table I :Experimental Result

Sr. No	Name of Author	Year	Algorithm	Results
1.	Li Lu, Pengfei Shi	2009	2DPCA+SVM	95.33%
2.	Samarasena Buchala et.al	2006	PCA+LDA	86.43%
3.	Swathi Kalam et.al	2014	By using threshold value of Measurement of facial distance	95.6%
4.	H. B. Kekre et.al	2014	PCA+MSE	95%
5.	Chandrakamal sinha et.al.	2013	PCA+SVM+ RBF Kernel	93.33%
6.	Dhanashri Lale et.al	2016	PCA+ Euclidaen distance classifier	97%

Table II: Comparison of Previous Research Work

In this paper the proposed algorithm is PCA and minimum distance classifier is used for the gender classification. It is observed that by using distance classifier the gender classification is 97%. In this project images with variation in pose are used for gender classification is successful with this face database. In future this project is modified for database of variations in different expression conditions.

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