School of Engineering and Applied Science,Ahmedabad University Gender Identification

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***Abstract*—Machine Learning is being used widely in diverse areas such as fraudulent systems, recommender systems, disease prediction, etc. One such application is gender identification which is exploited in this paper. For gender identification it is necessary to extract features of face.The objective of this project is to identify the gender of a person by looking at his/her photograph. This is a case of supervised learning where the algorithm is first trained on a set of female and male faces, and then used to classify new data.We have not taken genders other than Male and Female into account**

***Index Terms*—Face Detection, Gender Identification, SVM, Machine learning, classification algorithm, EigenFaces, K-Means**

I. Introduction

Gender Identification has become area of extensive research due to it's increasingly powerful applications. Moreover augmenting it in real time scenario can be useful in many applications in many fields. A successful gender classification could have great impact in improving human computer interactions. Practically it is imperative to improve the algorithms from time to time in order to achieve higher accuracy levels and build more accurate and robust systems.In our Project We tried to identify gender from facial features, we are often curious about what features of the face are most important in determining gender.Are localized features such as eyes, nose and ears more important or overall features such as head shape, hairline, face contour and many more.

In our Project Following Method are implemented for an classification Problem

1) Eigenface Method
2) K-Mean
3) SVM

II. METHODOLOGY

Our proposed face detection and sex classification system is described in Fig. 1.

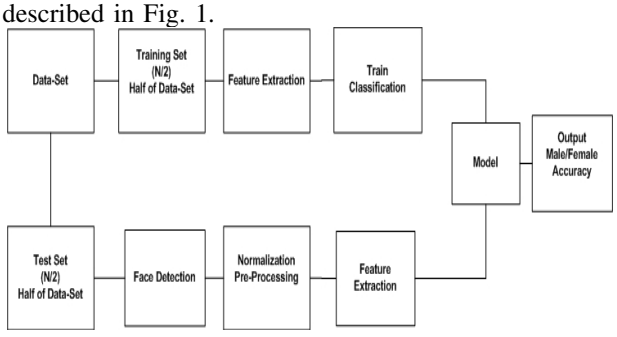

Fig. 1: Methodology

III. Previous Approach

A. Face Detection

The proposed algorithm first locates the face region using skin-color. The YCbCr color space is used to detect the skin region on the given input face image. The given input RGB image is converted into the YCbCr color space.

Color is a powerful cue of human faces. The distribution of skin clusters is in a small region of the chromatic color space. Processing color is faster than processing other facial features. Therefore, skin color detection is firstly performed on the input color image to reduce the computational complexity.

In the color detection process, each pixel is classified as either skin or non-skin based on its color components.

$$GammaRGB = (c1 * inputRGBimage)^{c21} + c3 \quad (1)$$

where $c1 = 1.0$, $c2 = 1.0$ and $c3 = 0.0$

The Y, Cb and Cr components are determined through the following formula using the constant C with the value 128. [1]

$$\begin{aligned} Y = (0.299 * (gammaRGB[0,i,j] - C) + C \\ +(0.114 * (gammaRGB[2,i,j] - C))) \end{aligned} \quad (2)$$

$$Cb = (0.564 * (gammaRGB[2,i,j] - Y) \quad (3)$$

$$Cr = (0.713 * (gammaRGB[0,i,j] - Y) \quad (4)$$

here, gammaRGB is the array with 0 represents the Red layer and the 2 represents the Blue layer. The range of Cb is between -50 and 2 while the range of Cr is between 10 and 100 determine the skin region.The skin image is estimated based on the threshold gray level between 20 and 80.

B. Facial feature Detection

1) Edge detection is done using Gabor's algorithm which implements linear approach..
2) A set of Gabor filters with different frequencies and orientations may be helpful for extracting useful features from an image.
3) In the discrete domain, two-dimensional Gabor filters are given by,

$$G_c[i,j] = Be^{(-(x^2+y^2)/2\sigma^2)} cos(2\pi f(icos\theta + jsin\theta)) \quad (5)$$

$$G_s[i,j] = Ce^{(-(x^2+y^2)/2\sigma^2)} sin(2\pi f(icos\theta + jsin\theta)) \quad (6)$$

where B and C are normalizing factors to be determined and f is the frequency being looked for in the texture. θ is the direction in which feature is to be looked for.

IV. Dataset

1) Label our Data set
   a) m = male
   b) f = female
2) Dimension is 48 * 48 pixel

V. SVM

[5] Support Vector Machine (SVM) is a supervised machine learning algorithm which can be used for both classification or regression challenges. we perform classification by finding the hyper-plane that differentiate the two classes very well.

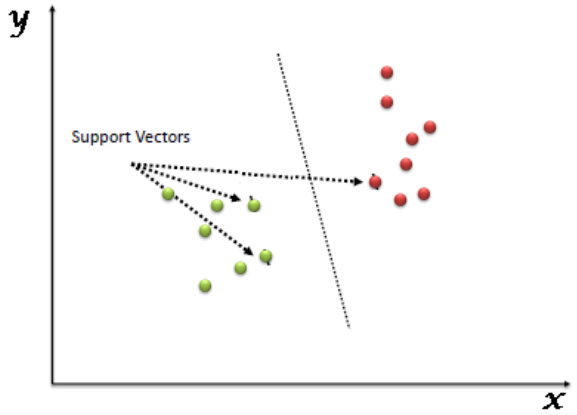

Fig. 2: SVM-1

1) You need to remember a thumb rule to identify the right hyper-plane: Select the hyper-plane which segregates the two classes better
2) maximizing the distances between nearest data point (either class) and hyper-plane will help us to decide the right hyper-plane. This distance is called as Margin.

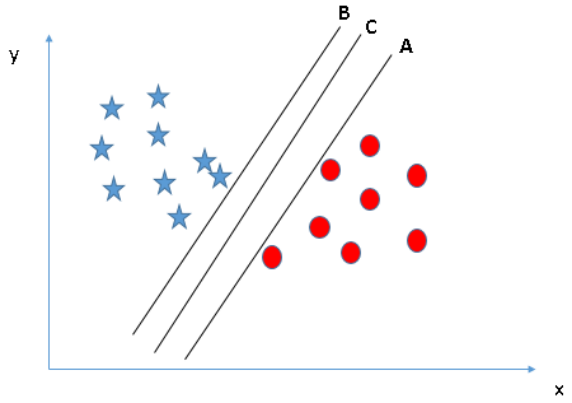

Fig. 3: SVM-2

3) SVM has a feature to ignore outliers and find the hyper-plane that has maximum margin
4) We have used sklearn library for SVM in python.

Gender	Error
Male	0.47
Female	0.53

Table-1 SVM for Dataset-1

Class Label	Precision	Recall	F1-Score
Male	0.88	0.88	0.88
Female	0.74	0.75	0.743
Avg/Total	0.81	0.81	0.81

Table-3 For Precision,Recall,F1 Score,Support

Class Label	Male	Female
Male	176	24
Female	23	70

Table-4 Confusion Matrix

VI. EigenFaces

Eigenfaces is the name given to a set of eigenvectors when they are used in the computer vision problem of human face recognition.the presence of some objects (eyes, nose, mouth) in any face as well as relative distances between these objects. These characteristic features are called eigenfaces in the facial recognition domain (or principal components generally). They can be extracted out of original image data by means of a mathematical tool called Principal Component Analysis (PCA). The eigenvectors are derived from the covariance matrix of the probability distribution over the high-dimensional vector space of face images.

Gender	Error
Male	0.64
Female	0.66

Table-1 EigenFaces for Dataset-1

Class Label	Precision	Recall	F1-Score
Male	0.73	0.2	0.313
Female	0.33	0.84	0.47
Avg/Total	0.53	0.52	0.39

Table-2 For Precision,Recall,F1 Score,Support

Class Label	Male	Female
Male	66	134
Female	60	33

Table-3 Confusion Matrix

VII. K-Means

k-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The main idea is to define k centers, one for each cluster. These centers should be placed in a cunning way because of different location causes different result. this algorithm aims at minimizing an objective function know as squared error function given by:

$$J(v) = \sum_{i=1}^{c} \sum_{i=1}^{c_i} (\| x_i - v_j \|)^2$$

Where,
$\| x_i - v_j \|$: Euclidean Distance
c_i: number of data point in i^{th} Cluster
c: number of cluster centers

Gender	Error
Male	0.79
Female	0.16

Table-1 K-Means for Dataset-1

Class Label	Precision	Recall	F1-Score
Male	0.63	0.68	0.77
Female	0.61	0.66	0.75
Avg/Total	0.64	0.67	0.76

Table-2 For Precision,Recall,F1 Score,Support

Class Label	Male	Female
Male	40	160
Female	15	78

Table-3 Confusion Matrix

VIII. Conclusion

For the Proper Gender Identification we need to Detect the face and need to detect the skin color,facial feature extraction,Geometric Distance between Extracted Feature and need to classify data into two class as follow

1) Male
2) Female

Eigenfaces

1) Advantages:the algorithm is basically identifying almost every new face to be male, hence contributing to the large error for females.
2) Disadvantages:it cannot give you an intuitive sense of why the algorithm is favouring males. But upon looking at the data where the algorithm misclassified the person, we conclude that female subjects who have short hair, hair tied back or in a scarf were almost always labeled male. Having insufficient examples for them to train on might have resulted in this outcome.

K-Mean[6]

1) Advantages:Faster then EigenFaces if variable are huge.
2) Disadvantages:Running time is too slow since it compute distance between each of the k nearest point

SVM

1) Advantages: Computationally better then Eigenfaces and K-Means
2) Disadvantages:When Dimension are very high then SVM result into large in-accuracy.

IX. Future Work

1) Train classifier to train images for gender classification i.e. person is male or female.
2) To detect gender of more than one person in real time video at the same time.

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