PERSON IDENTIFICATION AND GENDER CLASSIFICATION USING GABOR FILTERS AND FUZZY LOGIC

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Abstract –As Human –Computer Interaction technology (HCI) evolves computer vision systems for people monitoring will play an increasingly important role in our lives. Examples include human face detection, person identification and gender detection. Gender detection has many applications such as image and film processing criminal applications, and security checking system. Detection of gender by using the facial features is done by many methods such as automatically detected and aligned faces, artificial neural networks and support vector machine. In this work, Gabor filters and orthogonal basis functions are used for feature extraction and fuzzy logic is used for classification. The proposed system was tested with GTAV database. The proposed approach is evaluated with various poses other than the frontal pose.

Keywords- Gender Classification, Gabor filter, Orthogonal Basis Function, Feature Extraction, Database, Fuzzy rule table.

I. INTRODUCTION

Automatic gender detection through facial features has become a critical component in the new domain of computer human observation and computer human interaction (HCI). Automatic gender detection has numerous applications such as image and film processing criminal identification, security checking system. It is one of the most interesting and challenging field.

Gender is the range of physical, biological, mental and behavioral characteristics pertaining to, and differentiating between, masculinity and femininity. Gender classification is the process to specify an individual characteristic physically.

Due to advancement of Technology, gender detection in pregnancy has become more prominent these days. Even though we have technology to detect the gender of unborn child, detecting the gender of adult with only facial features is still a daunting task. Some of the innovative approaches to gender detection are described.

H.D Vankayalapat has contributed his work on frontal face detection system to classify the gender based on facial information and reliability is mainly based on edge detection and extraction of facial features. Here in this paper Support Vector Machine is used as the classifier. This works only on the front pose the image.

Moghaddam and Yang developed the first automatic system for combined face detection and gender classification. They used maximum likelihood estimation for face detection and for facial feature detection. For gender classification, they used several different classifiers. The experiments were carried out with a set of FERET images.

Roytatsu Iga et al., proposed an algorithm to classify gender and age using SVM classifier considering the features like geometric arrangement and luminosity of facial images. The graphical matching method is used with GWT method in order to detect the position of the face. For gender classification the following GWT features are considered geometric arrangement of color, hair and mustache and for age classification texture spots, wrinkles and flabs of skin are considered.

Jing Wu et al., presented his work on gender classification using Shape from Shading (SFS). The usage of Linear Discriminant Analysis (LDA) also exists based on Principal Geodesic Analysis parameters to distinguish male and female genders of test faces. This technique is used in order to improve the performance of gender classification in gray scale face images. A study on gender identification with automatically detected and aligned faces was presented by Roope Raisamo . BenAbdelkader and Griffin presented a method that extracted regions from the face and used them as input for an SVM or Fisher Linear Discriminant (FLD) gender classifier. Faces were aligned using the eye locations. For the experiments, they used images obtained from various databases.

Baback Moghaddam and Ming-Hsua proposed an appearance based method to identify gender through facial images using SVM nonlinear classifier and compared their results with traditional classifiers and modern techniques such as Radial Basis Function (RBF) networks and large ensemble-RBF classifiers, the differentiation in classification of performance with low-resolution and their corresponding her resolution images is just one percent Mallikarjuna Rao et al. has contributed his work on Neural Network-based upright invariant frontal face detection system to classify the gender based on facial information and reliability is mainly based on pixel value and geometric facial features. Robustness of classification depends on pi-sigma neural network and cyclic shift invariance techniques.

The upcoming topics of this paper are: discussing the preprocessing, how the eigen face created using eigen

matrix, gabor filter analysis, analysis of extracted features will be done, how the analysis of extracted results will be done, what kind of sample database have been taken and finally the gender detection is done.

II. PREPROCESSING

Using computers to do image processing has two objectives: First, create more suitable images for people to observe and identify. Second, that computer has to automatically recognize and understand images. Face image will undergo several processes in order to acquire a transformed face image which in turn increases the quality of the face image by holding prominent features of the face.

Intensity normalization is a kind of preprocessing technique. In image processing, normalization is a process that changes the range of pixel intensity values. Normalization is sometimes called contrast stretching or histogram stretching.

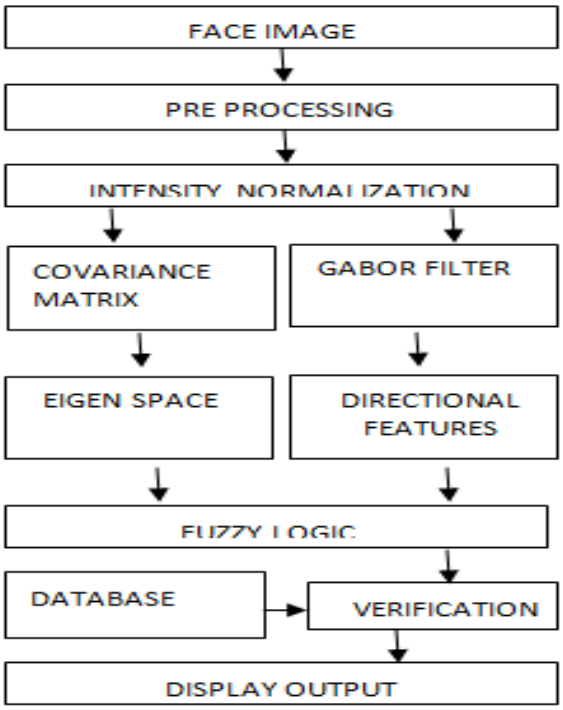

Figure 1: block diagram of proposed system

III. DATABASE

To determine gender we need to maintain some images in a specific database. The main purpose for the creation of database is to check the robustness in the gender recognition. The database includes 44 persons with different poses and illuminations. But here we consider only front pose images. The prominent and current objective for this database is for investigating the introduction of 3D model approaches in the image processing area. GTAV is an extension to the traditional approaches of PCA or LDA to a 2D space and addition to the introduction depth information

IV. FEATURE EXTRACTION

Transforming the input data into the set of features is called feature extraction. It is expected that the features set will extract the relevant information from the input data in order to perform the desired task.

Here for the feature extraction orthogonal basis functions and gabor filters are used.

i) Orthogonal Basis Function

Orthogonal moments have demonstrated many desirable properties in the field of image processing, especially in feature and face recognition; however they also demonstrate some data compaction properties. Orthogonal basis functions are independent of each other and each of them contributes to the function definition in a certain unique way.

Here for person identification, eigenimage analysis used. Compared to the traditional approaches which use object geometry only, the implementation described uses eigenspace determined by processing the eigenvalues and eigenvectors of the image set. For the practical implementation in order to decrease the number of image, the image set is obtained by varying pos while maintaining a constant level of illumination. The eigenspace is determined using the eigenvalues (eigenvectors) of covariance matrix in order to obtain a low dimensional subspace.

Let (x',y'); be the true position of a feature point (x, y). If the errors $\Delta x = x - x^{\wedge}$ and $\Delta y = y - y^{\wedge}$are regarded as random variables, their covariance matrix is written as

$$\begin{pmatrix} E[\Delta x^2] & E[\Delta x \Delta y] \\ E[\Delta x \Delta y] & E[\Delta y^2] \end{pmatrix} \qquad (1)$$

Where E [.] denotes expectation.

Next step s to calculate eigen pace. Eigen space is calculated as follows. Consider an image I(X,Y).To construct an image map a collection of eigen values in the huge space. The main idea is to find the vectors that can better describe the image.

These vectors describe an orthonormal space and this property is presented below.

$$u_i u_j^T = \gamma_{ij} = \begin{cases} 1, & \text{if } i = j \\ 0, & \text{if } i \neq j \end{cases} \qquad (2)$$

Where u_i and u_j are two eigenvectors and γ_{ij} is the scalar product. Suppose the normalized image can be represented as

$$i_n' = \frac{1}{B} i_n \quad , B = \sqrt{\sum_{n=1}^{N} i_n^2} \qquad (3)$$

Before computing the eigenspace average image (A) of all images is calculated.

$$A = \frac{1}{P} \sum_{i=1}^{p} I_i' \qquad (4)$$

Then the image set is obtained as

$$S = [I_1' - A, I_2' - A, .. I_P' - A] \qquad (5)$$

S is a $P \times N$ matrix where P is the number of positions and N is the number of pixels.Ihe eigen

value and the corresponding eigen vectors are computed solving the following equation. $Qu_i = v_i u_i$

u_i is the ith eigen vector and v_i is the corresponding eigen value. Then eigen space is obtained by

$$E = US \quad (6)$$

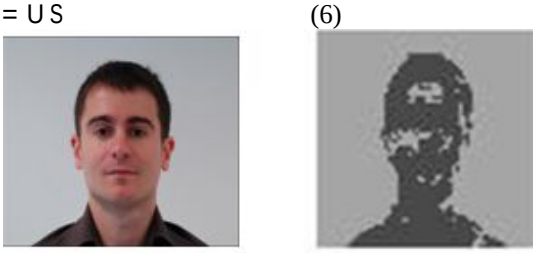

Fig 2 (a) Original input image from GTAV database (b) eigen face corresponding the image

Fig:3 After feature extraction

Next step is the person identification .Once the eigenspace is computed project all images from the set on this subspace. The result is the collection of points that describe the object. An unknown image will be projected onto the eigenspce and the obtained result is a P dimensional point. The simplest method to determine the best matching is to compute the Euclidian distance. The object is in the collection when the object gives the minimum distance.

(ii) Gabor Filter

A two-dimensional Gabor filter can be viewed as a complex plane wave and an elliptical Gaussian. The even and odd Gabor filters in the 2-dimensional spatial domain can be formulated as,

$$g_{e(x,y,\lambda,\theta)} = e^{-\frac{1}{2}\left(\frac{x^2}{\sigma_x^r} + \frac{y^2}{\sigma_y^2}\right)} \cos\left(2\pi \frac{x}{y}\right) \quad (7)$$

$$g_{e(x,y,\lambda,\theta)} = e^{-\frac{1}{2}\left(\frac{x^2}{\sigma_x^r} + \frac{y^2}{\sigma_y^2}\right)} s\,in\left(2\pi \frac{x}{y}\right) \quad (8)$$

Where λ is Gabor filter wavelength in pixels, θ is the angle of filter in degrees, k_x , k_y scale factors specifying the filter shapes of the filter invariant to scale, $k_x$controls the sigma in the x direction which is along the filter, and hence controls the bandwidth of the filter. k_y controls the sigma across the filter and hence controls the orientation selectivity of the filter; $\sigma_x = \lambda k_x$and $\sigma_y = \lambda k_y$ the response of the filter in to an image i(x, y) can be calculated with the convolution

$$G_{e(x,y,\lambda,\theta)} = G_{e(x,y,\lambda,\theta)} \times i(x,y) \quad (9)$$

$$G_{o(x,y,\lambda,\theta)} = G_{o(x,y,\lambda,\theta)} \times i(x,y) \quad (10)$$

$$G_{e(x,y,\lambda,\theta)} = \sqrt{G^2_{e(x,y,\lambda,\theta)} + G^2_{o(x,y,\lambda,\theta)}} \quad (11)$$

V. FUZZY LOGIC CLASSIFIER

Fuzzy Logic offers several unique parameters which alternatively produces better results in many control problems. The process of fuzzy logic is explained as follows. Firstly, a crisp set of input data are gathered and converted to a fuzzy set using fuzzy linguistic variables, fuzzy linguistic terms and membership functions. This step is known as fuzzification. Afterwards, an inference is made based on a set of rules. Lastly, the resulting fuzzy output is mapped to a crisp output using the membership functions, in the defuzzification step .Fuzzy logic here is used to calculate the percentage of various male and female features presents in the given database.

VI. EXPERIMENTAL RESULTS

The proposed approach seems to be promising with the test performed on the images of GTAV database by using the matlab. Initially orthogonal basis functions and gabor filters are applied for feature extraction. Each feature considered as a weight .After that fuzzy logic classifier classify the gender.

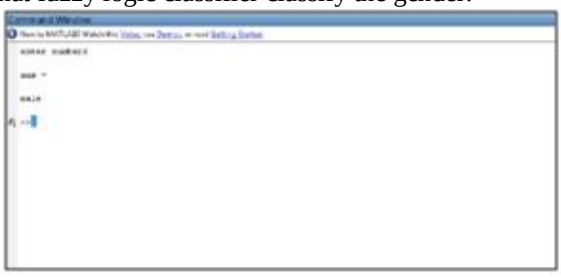

Fig:4 Gender detection

CNCLUSION

Detecting gender through gabor filter and orthogonal basis function is a good achievement in a modern era of computer world. This application is really working in many other fields.. The future work should focus to detect different classes like flowers, animals etc.

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