ISSN: 2321-7782 (Online)
Volume 2, Issue 10, October 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

# An Efficient Person Identification System using Face

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***Abstract:*** ***Authentication of a person using biometrics has become more popular research work today in the field of computer vision. Face, iris, retina scan, finger print, voice are mostly used for identifying and verifying an individual. In this paper, we present an efficient person identification system using face based on haar features, Bayesian Classifier and Histogram matching algorithm. The Haar features along with Adaptive boosting technique are used to detect and localize the face. The detected face is used for identifying an individual effectively. To recognize the person, we use an image comparison algorithm for identifying whether the person is genuine or imposter. The algorithm comprises of two parts, features extraction and features matching. This system can present results effectively even if the system has slight occlusions, vary in illumination and different poses of face. We present the experimental results of our algorithm on our proposed collage database and MUCT database.***

***Keywords: Haar features; Bayesian Classifier; Face detection; Image Comparison; Adaptive boosting Technique.***

## I. INTRODUCTION

The increased need for security system in state paved more attention for person identification and detection. Biometric person authentication can be done using various methods like fingerprint recognition, retina scan, iris scan, voice print and facial scan. Authentication process is done using something that you have(smartcards etc.,) or something that you know(passwords, PIN) or something that you are(face, iris, fingerprint, voiceprint). In this paper we use face for identifying a person. Face detection is generally categorized into two types, Appearance based approach and Geometry based approach. Appearance based approach refer to the characteristics of the image known as features. However this technique requires good quality of image to extract features correctly. Geometry based approach refers to the geometrical features of the face like distance between eyes, eyebrows, mouth.

For effective face detection method, the system must be unvarying to illuminance, clamber color and occlusion. The Haar grounded face detection method is enforced in this system. It is highly robust technique for detecting a face. The detected face is used for person identification. Image comparison algorithm is applied on the detected face to identify whether the person is genuine or impostor**.** For authenticating a person whether the captured image is genuine or not image comparison algorithm called Histogram color matching algorithm is used. The proposed algorithm consists of two main steps feature extraction and similarity measure between features of detected face. Our proposed algorithm for authentication gives results efficiently and it is a fast processing method than existing methods. After authentication gender classification is applied on the genuine person to check whether the person is male or female.

Gender classification can be done using various methods like gait, hand, face and iris. But gender classification using facial features has given major priority due to its increased attention. Gender classification refers to designate an image of a person

into one of the categories of male or female. At present days people need a machine for authentication which is reliable and easy to use. So for such growing demands approaches like face recognition, gesture recognition and gender recognition has been provided by the machine vision. The facial images may contain the variation in illumination, pose, background clutter, and partial occlusion. We consider all these variations in facial image and develop a reliable method to identify the gender. Gender identification methods can be divided into two main categories: geometry based and appearance based. The geometry based category focuses on extracting the geometry feature points from the facial images and describing the shape structure of the face. The appearance-based category can further be divided into two approaches: texture-based and statistical based. The former uses different texture descriptors to characterize a facial image about gender. The statistical-based approach aims at using different features which are quantified into probability to characterize a facial image about gender according to their visual traits [11].

Several face detection and gender classification methods are presented in literature. John se [5] proposed a probabilistic Bayesian classifier to recognize faces in video sequences. It introduces joint probability functions that encodes casual dependency between video frames. It achieved better recognition rate compared to conventional voting methods and Naive Bayesian classifier. Zixi Xu, Li Lu and Pengfei shi ,[6] proposed a hybrid method of fusing appearance features and geometry features. Haar wavelet is used to represent the appearance features and Adaboost is used to select strong features. Local features are extracted by Active Appearance Model. Experimental results show that hybrid method obtains high accuracy. Fok Hing Chi Tivive, and Abdesselam Bouzerdoumet al. [7] proposed a method using shunting inhibitory convolutional neural network. Face detection and gender classification is done using same neural network. The detected face is given as input to gender classifier. It is tested on two databases. It shows accurate results upto 97.2% for gender classification.

This paper proposes an integrated system for effective face recognition and identification by combining Haar based face detection with image comparison algorithm and Bayesian classifier. The intended system provides an effective system for following problems. The proposed system detects the face, recognizes the faces and also checks for the similar face in the given database. This paper is organized as follows: In Section II, proposed face detection, image comparison and gender classification algorithms are explained. Observational results and analysis is presented in Section III. Conclusion is presented in Section IV.

## II. PROPOSED ALGORITHM

Our proposed system consists of three main core modules: The face detection module which scans the captured image for face and detects the face in image. The second module is authentication it is done using image comparison algorithm histogram for detected face and checks whether similar face is available in provided database or not. The third module in gender classification module, for every detected genuine face it extracts the features using PCA and classifies the gender using Bayesian classifier which is based on probability method. The block diagram for proposed algorithm is shown in fig.1

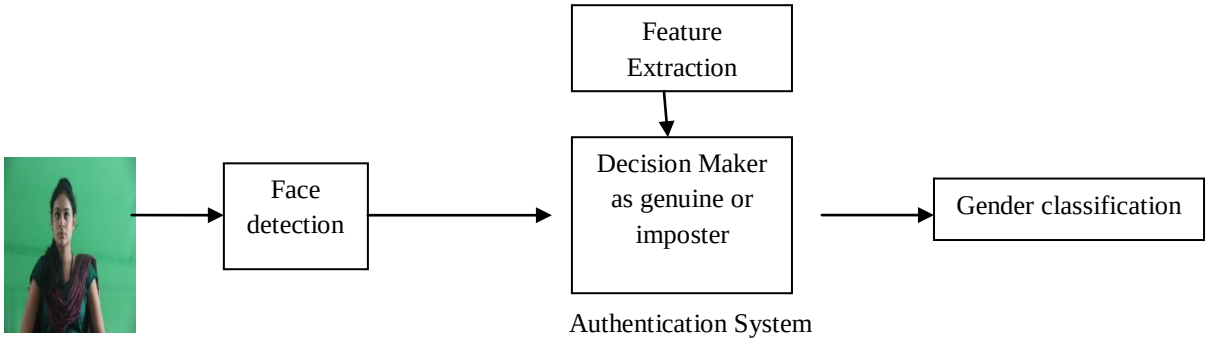



Fig. 1: Flow Chart of proposed person identification system

### A. *Haar Based Face Detection*

In this paper we use a viola jones method called Haar cascade classifiers for face detection. In image face can be different locations and can be in different sizes. So inorder to recognize the face in image we use window sliding technique which is developed by viola jones. This method classifies all the portions in image at all locations and detects the face.

Haar cascade classifier which is used for detecting objects is mainly based on Haar like features. There are numerous scales, positions and kinds for haar features. There structure and scheme is simple. Haar features are the reminiscent of Haar basis functions, which are basically rectangular features. The different templates for extracting features are shown in Figure 2. Each feature consists of connected black and white rectangles. The Haar feature's value are calculated as the weighted sum of the two components, the pixel sum over the black rectangle and the sum over the whole area. The weights of the two components are of opposite sign and inversely proportional to the area of their respective rectangles.

$$F(x) = Sum_{black\ rectangle}(pixel\ gray\ level) - Sum_{white\ \ rectangle}(pixel\ gray\ level)$$

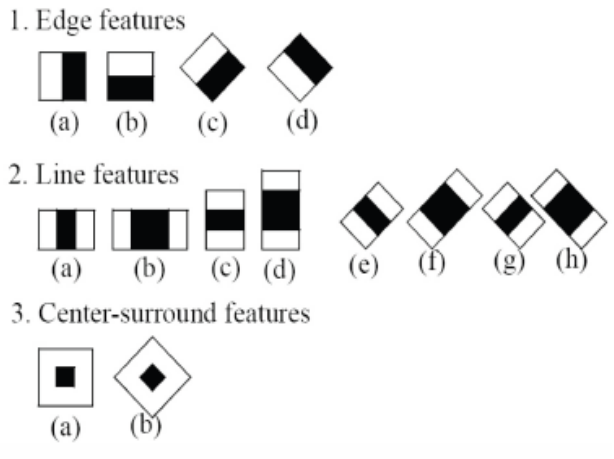
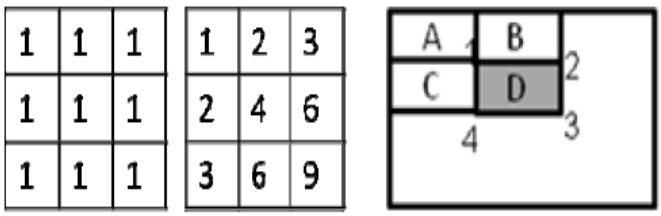



Fig. 2: Rectangular Haar Features

An intermediate representation called integral image concept is used in haar like features to compute the features fastly. Adaboost is used select strong features from it as Haar like features is a weak classifier and gives more number of features.

$$Integral(x,y) = \sum_{x' \le x, y' \le y} image(x',y')$$




(a) (b) (c)

Fig. 3: (a) Input image (b) Integral image computation for input image (c) Caluculation of the rectangular box from integral image.

For computing the feature of rectangular block D, the valuate is given as

$$SumD = Integral3(x,y) - Integral4(x,y) - Integral2(x,y) + Integral1(x,y)$$

In haar the features are elicited using detector windows of various size. A prominent set of features are extracted that are larger than pixel number and computation of such set is highly expensive. A very little number of features can form an efficient classifier. To find these effective features we use ada-boost classifier which trains the classifier.

i) *Ada-Boost algorithm :* Adaptive Boosting algorithm is a type of algorithm which is used along with other algorithm to make it strong classifier. In our proposed system we use Ada-boost algorithm along with haar classifier to make haar classifier a strong one. Boosting is a binary class classifier. It is trained on weak classifier to make it strong. The decision ambos in general are used as mere weak classifiers.

ii) *Cascade classifier :* As most of the region in image is non-face region. A simple method is to be introduced to check whether the window is face or not face region. If the region is not face, then discard that region. And focus on the region where there can be face. This can be achieved by using cascades classifiers.

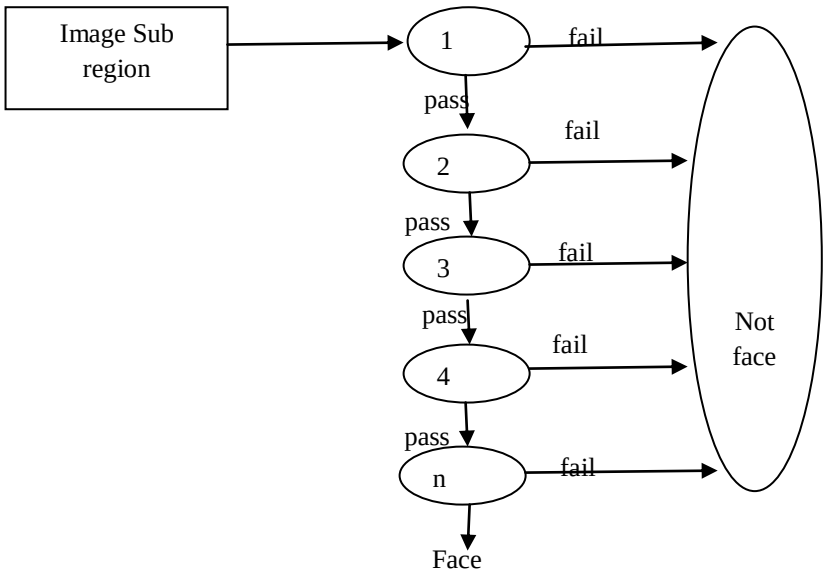



Fig 4: Cascade Classifier for face or not face.

### *B. Authentication*

The detected face is used for authentication to check whether the person is genuine or imposter. Here for authentication we use image comparison algorithm which checks whether the similar detected face is present in database or not. For comparison we use Histogram matching algorithm. Image comparison mainly contains two steps, Feature extraction from image and then similarity measure between features in captured image and database images.

In our proposed algorithm Histogram color matching algorithm is used for image comparison. RGB colors are extracted from detected face as features and check the similarity measure between features using Euclidean distance. For similarity measure to calculate Euclidean distance the extracted features are constructed in the form of nxn matrix form. If the distance calculated is 0 then captured image matches with database image and person is genuine. Otherwise person is imposter and the captures face image is not present in database.

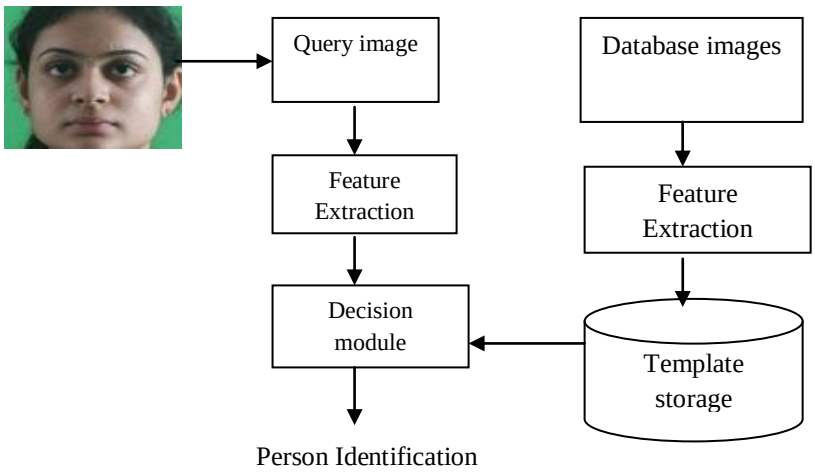



Fig 5: Architecture for authentication

### C. Gender Classification

In our proposed technique for gender recognition it contains two steps, Feature extraction and gender recognition. Principal Component analysis is used for feature extraction and Bayesian classifier is used for gender recognition.

i) *Principal Component Analysis:* Principal component analysis is used for feature extraction. PCA is used for reducing the dimensionality of data. It involves a mathematical procedure to transform number of possible correlated variables into a small number of uncorrelated variables called principal components. It is a popular technique to derive a set of features for face recognition. For applying PCA to images, the image is first represented as a column vector. A column matrix is forged by adding the column of set images. Let matrix be X.

$$X = [X_1, X_2, \ldots\ldots, X_n]$$

$X$ is the *nx1* column vector implementing training image.

The mean is deducted from each column and the covariance matrix is computed.

$$C_{ij} = \frac{1}{n-1}\sum_{m=1}^{n}\left(X_{im} - \bar{X}_i\right)\left(X_{jm} - \bar{X}_j\right)$$

These vectors are known as principal components span the low dimensional subspace. Out of these eigen vectors m most significant vectors are chosen, let these vectors be $e_1, e_2, \ldots\ldots, e_m$. The value of m is chosen by considering the cumulative sum of eigen values. The features of image X is then computed by projecting it onto the space spanned by eigen vectors as follows

$$g = [e1, e1, \ldots\ldots em]^T \ (X\text{-}X\hat{}),$$

where g is an m dimensional feature vector. During training and classification this vector g is used.

ii) *Bayesian Classifier:* For classifying the gender of genuine face in our proposed technique we use Bayesian classifier which is also called as probabilistic network and belief network. Bayesian network classification contains mainly two steps, Inference and Learning. Inference is the task of computing the probability of each state of a node in a Bayesian network when other variables are known. Dividing set of Bayesian network nodes into non-overlapping subsets of conditional independent nodes. Learning task is completing the missing beliefs in the network. Adjusting the parameters of the Bayesian network so that the probability distribution functions defined by the network sufficiently describes statistical behavior of the observed data

Bayesian network is based on probability similarity measure. The picture intensity level difference is measured as $\Delta = I_1 - I_2$ Facial image variations can be divided into two classes, Intrapersonal variations $\Omega_I$ and Extrapersonal variation $\Omega_E$.

The similarity measure of images is expressed as

$$S(I_1, I_2) = P(\Delta \epsilon \Omega_I) = P(\Omega_I | \Delta)$$

Where $P(\Omega_I|\Delta)$ is posterior probability of bayes rule, using the estimates of likelihood $P(\Delta|\Omega_I)$ and $P(\Delta|\Omega_E)$.

$$S(I_1, I_2) = P(\Omega_I | \Delta)$$

This Bayesian conceptualization cast the problem into binary rule classification with $\Omega_I$ and $\Omega_E$. And it is then solved using Maximum a Posterior (MAP) rule

### D. Databases

Our experiment has been applied on two types of database images. Our proposed collage database which contains 10 images of each person and each image of size 480x640. Our experiment is tested on theses images which gave 92%accurate

results. It is also tested on another database called MUCT of 200 images . We have arbitrarily select 85%images for training set and 15% as testing set.

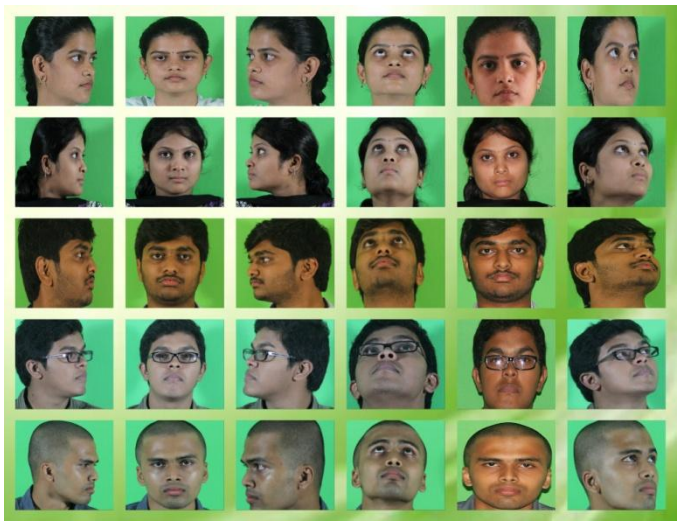
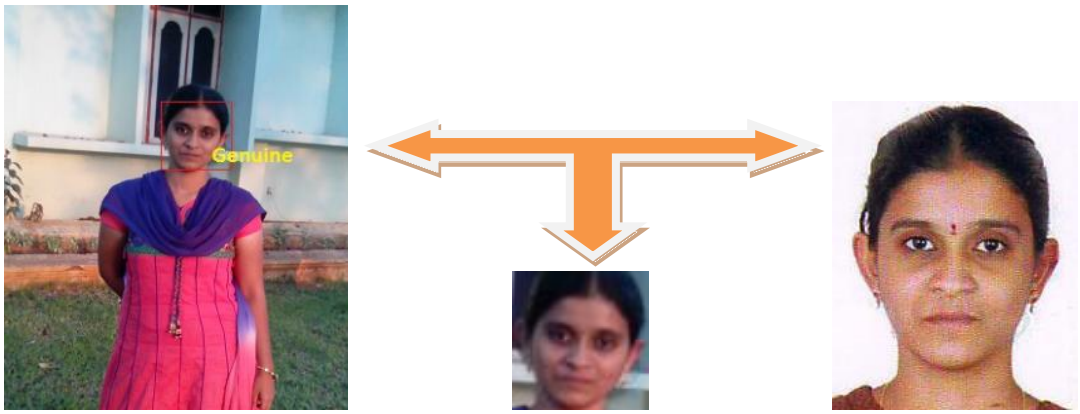


Fig 6: A sample set of our collage database

## III. Implementation and Experimental Rules

In our experiment Haar and Bayesian Based face recognition technique is tested on our proposed collage database and MUCT database. The captured image is given as input to the face detection method which gives 95% accurate results for detecting face. The detected face is used to check whether the person is genuine or not. Image comparison algorithm is applied on the detected face to check for authentication. If the similar image is present in the database then that person is genuine. For genuine person it classifies the gender using Bayesian classifier which give accurate results more than 96%. The algorithm is tested on java.




(a) Person Identification (b) Recognised Face (c) Database Face

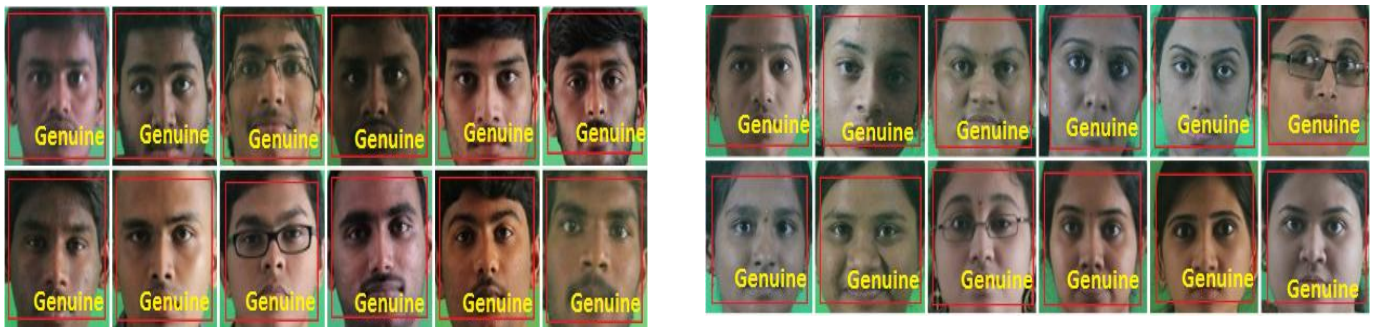
Input Image : 0 1 TestSubject1 C:\face\test\wc\23_16.JPG

Gender Estimation Process Completed. Result : Female

(d) Gender Recognition

Figure 7: Result of Person Identification System




(a) Authorised Male images (b) Authorised Female images

Fig 8: Results of person identification system who are trained by the system.


Fig 9: Results of person identification system who are not trained by the system

## IV. CONCLUSION

In this paper, an approach for identifying a person is developed based on image comparison algorithm, Haar and Bayesian for classification. Face detection is done based on haar features which give more accurate results. PCA is used for dimensionality reduction and statistical approach Bayesian classifier is used for effective gender classification. Image comparison algorithm uses Facial features and provides person identification system with good recognition rate and performs well.

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