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Different Characteristics of Examination for Human being Recognition

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Abstract: *Biometric techniques such as face recognition have a wide range of applicability in the field of Research and Development. Close circuit television cameras (CCTV) for high order of surveillance are being used in order to maintain security by capturing real time videos at public places as well as offices on a day to day basis. As it is least concerned by cooperation from the object being recorded the face recognition are portraying a vital role in the field of surveillance and are being accepted globally. The detection of a human face encounters problem with regards to computer vision due to its dynamicity which has to incorporate many variables altogether. The acceptance as well as the uniqueness offers as the prime advantage to face recognition as compared to various biometrics available. The key points included with regards to identification of a face are primarily speed incorporated with accuracy. This paper aims to initiate an improved level of response for video surveillance through assessment as well as by deciphering an integrated solution for different face recognition and detection methods with higher order of precision. In order to provide a solution, a number of tests were performed on different Face databases that include subject's race, emotion, brightness and posture.*

Keywords: Biometrics, face detection, face recognition, face identification

I. INTRODUCTION

Biometrics has been a burning issue for past decades and so a lot of advancements have been observed in face recognition and detection since the cooperation from the individual is not necessary along with the fact that it is the most efficient method to detect the identity of an individual's. The inception of various methods for face recognition and detection acts as a turning point in the field of biometrics. Earlier the above mentioned methods were implicated couple of times solely for a definite set of data to perform similar tasks whereas there is no previous work available in order to assess the comprehensive performance of these methods collectively by implementing them on complex datasets, details being given in section IV.

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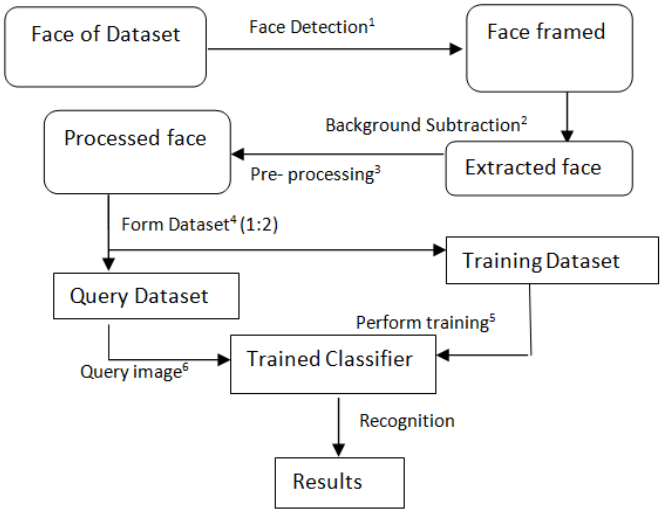

Fig. 1 System's Overview

This paper is the first breakthrough that presents a defined system of assessment for the above mentioned methods in order to perform surveillance through video based face recognition and detection. Demonstration of an overview of present system is given below in fig.1.

II. FACE DETECTION

Haar and Local Binary Pattern (LBP) features are employed along with AdaBoost classifier and a Histogram of Oriented Gradients (HOG) feature is employed with Support Vector Machine (SVM) classifier for evaluation of face detection.

Through the application of new image representation which produces large set of features and in order to reduce degenerative tree of boosted classifiers AdaBoost–a boosting algorithm Haar-like features are analyzed. Because of various merits of Simple rectangular Haar-like features such as increase in speed for pixel based systems in addition to sorting of ad-hoc domain knowledge they are applied for vigorous and quick speculation. It also becomes relatively simple for the computation of intensity difference readings that are equivalent to basic function of Haar. An enormously large feature set was achieved by executing the system with such features thereby restricting the feature set to a minimal critical feature that was accomplished through boosting algorithm AdaBoost .

A binary number is generated by thresholding the central pixel value with 3X3 neighbourhood of each pixel which in turn is labelled by the original LBP operator. Every face image is regarded as a configuration of micro patterns that are detected efficiently by LBP operator. A face image is divided into N small non-overlapping regions T_0 , T_1, T_2,..... T_N, in order to review shape information regarding faces. From each sub-region the LBP histograms are collected and Integrated into a single, spatially enhanced feature histogram denoted as:

$$H_{i,j} = \Sigma_{x,y} I(f_l(x,y)=i)\ I((x,y)\epsilon T_j)$$

Where i=0,1,.....,L-1; j= 0,1,....., N-1. The global shape as well as the local texture are described with the help of extracted feature histogram

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Example

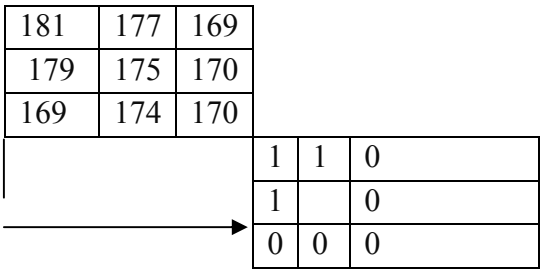

Fig. 2 LBP Calculation

Along with HOG features SVM classifiers are also applied. Prior to the evaluation of gradient damages HOG considerably surpasses the wavelets and the degree of smoothing. At the borders, abundant facts are found at exquisite size. To lessen the degree of accuracy to spatial position, blurring them is a source of error.

In order to yield accurate results it is mandatory to evaluate the gradient at the optimum scale available in present layer of pyramid in addition to the strong localised contrast. Although a binary value, the class of the object is yield back through the formulation of SVM with regards to solving a classical two class problem. The formulation of a problem set in different space which exclusively acquires the distinction in two facial images is done to upskill the SVM. Summary of the outcome of methods mentioned above are as follows.

Table 1: Face Detection result Summary

Dataset	**Detection**		
	AdaBoost		**SVM**
	Haar	**LBP**	**HOG**
[1]	99.32%	95.22%	92.68%
[2]	98.33%	98.96%	94.10%
[3]	98.31%	69.83%	87.89%
[4]	96.94%	94.15%	90.58%
[5]	90.65%	88.31%	89.18%
Mean	**96.70%**	**89.30%**	**90.88%**

Depending on the system illustrated above is tested on datasets, results are as given below:

Fig. 3 Face Detection

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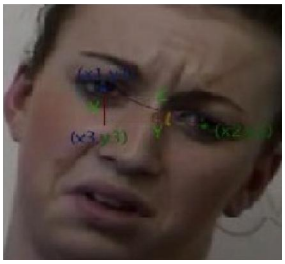
To upgrade the recognition outcomes in the pre-processing stage two surplus actions are performed so that the illumination and the posture variations are minimum: I) Histogram Equalization; ii) to get rid of the position of face head tilt, turn and slanting, eyes detection is done as in Fig. 4.



$P_1 (x_1, y_1)$: $P_2 (x_2, y_2)$ ~~P_3~~ ($x_3 = x_1$, $y_3 := y_2$)
$X = (x_3 - x_1)/(y_3 - y_1)$; $Y = (x_3 - x_2)/(y_3 - y_2)$
Rotation angle= $\theta = \tan^{-1}(X/Y)$

Fig.4 Face Rotation

III. FACE RECOGNITION

2-D face recognition problem- Eigenface, frontal as well as upright faces would be obtained. Therefore it is not essential to get a 3-D information of a face which in turn significantly minimizes the complexity. Directions for a more potent portrayal of the data are sought by the principle components of Face image as it is mandatory to transform the face images to a set of basic functions. It leads to minimizing the efforts required for a particular computation. Since enormous number of pixel values are used for representation of a face therefore in order to lessen the features to a comparatively feasible numbers prior to recognition Linear Discriminant Analysis is applied at an earlier stage. Every new dimension is a linear combination of Pixel values that forms a template. Fisher faces is the linear combination that was obtained through Fisher's linear discriminant. LBP

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is an order set of binary comparisons of pixel intensities between central pixel and its eight surrounding pixels.

$$LBP(x_a, y_a)= {}^{7}\Sigma_{n=0}\, s(i_m - i_a)2^n$$

Where i_a =value of central pixel (x_a, y_a), i_m =value of surrounding 8 pixels, function f(x) is as follows:

$$f(x) = 1 \quad \text{if } x>/=0$$
$$f(x) = 0 \quad \text{if } x<0$$

Prominent visual characteristics like spatial frequency and localization along with the selectivity of orientation are accomplished with the help of Gabor filters. After taking into consideration the substantial success in face recognition and the crippling capacities of Gabor features, it was found that these have no susceptibility to transfiguration in parameters such as luminescence, posture and the facial expression in spite of the fact that these are not formulated for face recognition. It has a predefined transfiguration rather than comprehending from the face training data. Besides global features are assessed through LDA and PCA classifier while the local features are assessed through Gagor and LBP classifiers. Depending on these present facts the results of the experiment are given below:

Table 2: Face recognition results summary

Dataset	Recognition			
	PCA	LDA	LBP	Gabor
[1]	72.10%	79.39%	86.93%	93.49%
[2]	69.87%	76.61%	80.47%	89.76%
[3]	70.95%	78.34%	85.14%	92.68%
[4]	74.79%	81,93%	86.45%	96.91%
[5]	68.04%	73.21%	77.69%	88.93%
Mean	**71.15%**	**77.90%**	**82.94%**	**92.35%**

IV. DATASETS

For the experiment performed above numerically 5 datasets are applied:

Dataset [1]- Face collection having solid green backdrop setting, it is incorporated with slight modification in head tilt, turn, slant and significant changes in expressions and positioning of face while no illumination and head scale variation was done.

Dataset [2] – Face collection with red curtain backdrop setting which is incorporated with slight modification in head tilt, turn and slant; large head scale alterations, slight expression alterations, transformation in face position and illumination alterations, since fluctuations are induced by shadows when the object advances forward.

Dataset [3] –face collection with intricate backdrop; incorporated with slight alterations in head tilt, turn, slant and facial expression, major head scale alterations, minor transformation in positioning of face and major illumination alterations as the object moves in simulated light.

Dataset [4] – face collection with plain backdrop; significant alteration in head tilt, turn, slant and considerable alterations in facial expressions, minor head scale alterations, small transformations in illumination alterations and positioning of face.

Dataset [5] –face collection with constant backdrop; incorporated with slight head scale alterations and illumination alterations, significant alterations in head tilt, turn, expression and positioning of face.

V. CONCLUSION

A system is established in this paper in order to assess the face recognition and detection methods in accordance with the methods that are regarded as benchmark till date. On application of the five datasets an assessment is done depending on average outcome for the experiment, as some methods performed incessantly over different datasets while other methods performed haphazardly. The result summary for Face detection and recognition is given in Table 1 and Table 2 respectively and Table 3 gives the Datasets summary. Although Haar-like features executed better outcomes but have much false detection as compared to LBP which in turn can be projected for surveillance in future. As the qualities of Gabor overcome the complexities of the datasets it is considered well for the purpose of recognition.

Table 3: Face Database Summary

Dataset	Sub-division	Images	Resolution	Individuals	Image/Individual
A	Face 94	3178	180*200	153	~20
	Face 95	1440	180*200	72	20
	Face 96	3016	196*196	152	~20
	Grimace	361	180*200	18	20
B	Pain Expressions	599	720*576	23	26

A: Face Recognition Data, University of Essex

B: Psychological Image Collection at Stirling (PICS)

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