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An Enhanced AAM Approach for Face Recognition Application

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Abstract- Face recognition systems are considered to be the most user-friendly systems in the biometric world. Also, they are one of the active research fields in which the researchers work to improve the efficiency and efficacy of biometric applications. The major challenges reside on these applications are to extract unique and differentiable features that are not disturbed by pose, illuminations and other environmental and physical variations. Active Appearance Model (AAM) is one of the population solutions that extract features by precise modeling of human faces under various physical and environmental circumstances. In this paper, an Enhanced AAM based 1 to N face recognition system is proposed. The experimental results show the performance of the proposed face recognition system.

Keywords: biometric, Face Recognition, shape, appearance, AAM

I. INTRODUCTION

Nowadays, face recognition is one of the active research fields for computer and machine vision researchers [1]. Within computer vision, face recognition has become increasingly relevant in today's society. The recent interest in face recognition can be attributed to the increase of commercial interest and the development of feasible technologies to support the development of face recognition. A face recognition system is a computer vision, which automatically identifies a human face from database images. The face recognition problem is challenging as it needs to account for all possible appearance variation caused by change in illumination, facial features, occlusions, etc [2]. Face recognition is one of the most important biometric, which seems to be a good compromise between actuality and social reception and balances security and privacy well [3]. Face recognition system fall into two categories: verification and identification. Face verification is a 1:1 match that compares a face images against a template face images, whose identity is being claimed. On the contrary, face identification is a 1: N problem that compares a query face image against all image templates in a face database. Face localization, feature extraction, and modelling are the major issues in automatic facial recognition [4]. Several researchers have evaluated the task of face recognition. The prior face recognition methods have used geometry of key points (like the eyes, nose, and mouth) and their geometric relationships (angles, length, ratios, etc) [9]. Among such several face recognition methods, Active Appearance Model (AAM) is a most famous technique.

The Active Appearance Model (AAM) defines the appearance of the face [5]; it creates statistical model of shape and appearance of any given object. It has been widely used for modeling human face shape and appearance [6]. The model combines constraints on both shape and texture by learning statistical generative models for the shape of a face and the appearance of a face. Shape is represented by landmark positions, whereas the appearance is represented by pixel intensities in the shape-free face image [5] [7]. In training phase, AAM takes a set of images and the corresponding landmark points as an input and produces model parameters as output. The power of AAM lies in the fact that it can synthesis or explain any given object shape and appearance with compact set of parameters [6].

II. RELATED WORK

The complexity in face recognition emerges from the variability of the appearance of a human face. While the identity is preserved, the appearance of a face may change due to factors such as illumination, pose or facial expression. To recognize a person independent of pose, it is necessary to separate shape from texture information. Thus, **Thorsten Gernoth *et al.*** [8] have concentrated on the texture part in this work. Initially, they have fit an active appearance model to a given facial image. The shape information has been used to transform the face into a shape-free representation. The transformed face has been decomposed into local regions and extracted the texture features from these not necessarily rectangular regions using a shape-adapted discrete cosine transform. The texture features used for face recognition were independent of pose and shape of the face. They have demonstrated that these features contain sufficient discriminative information to recognize persons across changes in pose. **Thorsten Gernoth *et al.*** [9] have addressed the estimation of the facial pose as a first step to deal with pose changes. They have presented a method for pose estimation from two-dimensional images captured under active infrared illumination using a statistical model of facial appearance. An active appearance model has been fitted to the target image to find the facial features. The fitting algorithm has been formulated using a smooth warp function, namely thin plate splines.. **Rabiul Islam *et al.* [10]** have introduced a face recognition system that contributes the feature and decision fusion in challenging environment. Also, they have investigated the proposed facial recognition system in typical office environment conditions. Though the traditional HMM based facial recognition system was very sensitive to the facial parameters variation, the proposed feature and decision fusion based face recognition was found to be stance and performs well for improving the robustness and naturalness of human computer-interaction.

III. PROPOSED METHODOLOGY

The main aim of this research is to offer a better face recognition technique by solving the drawbacks that currently exist in the literary works. Thus, this research has been intended to propose an efficient face recognition technique using Active Appearance Modal (AAM). The proposed face recognition system includes three stages namely, preprocessing, feature extraction, and recognition. Initially, the proposed technique will perform preprocessing on the input training face images and then, this preprocessed face images will be subjected to the feature extraction process. In feature extraction stage, the feature vectors will be extracted from the face images by AAM. In addition, the face will be recognized in face recognition stage. The proposed technique will be implemented in the working platform of MATLAB and the results will be analyzed to demonstrate the performance of the proposed efficient face recognition technique. The proposed technique basic structure is shown in figure (1).

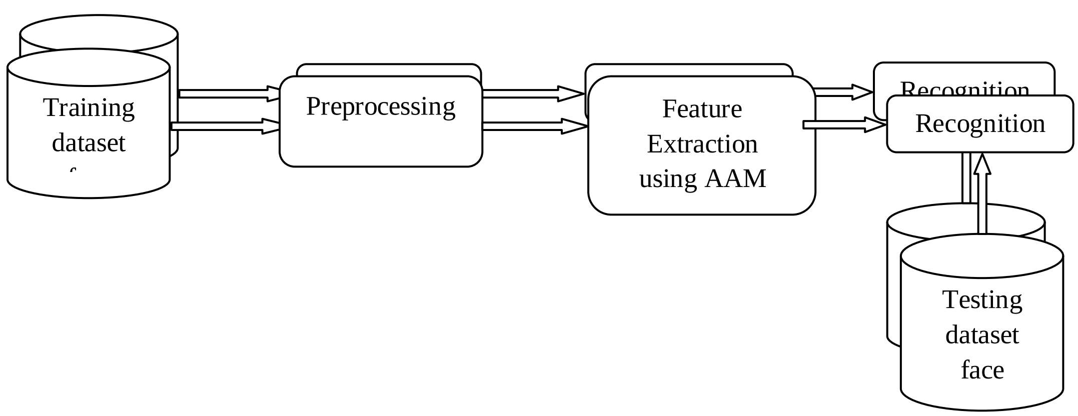

Figure (1) block diagram for the proposed face recognition Technique

IV. PREPROCESSING

To reduce the variations as well as the illuminations and poses that existed in the input images. Some of the preprocessing steps are used for this stage .Another reason is to detect the important features in the image and to avoid the extra or unnecessary parts.

V. FEATURE EXTRACTION USING ENHANCED AAM

Given a set of training images, $I_i(x,y)$; $x = 0,1,\cdots,M-1$, $y = 0,1,\cdots,N-1$ and $i = 0,1,\cdots,N_I-1$, where $I_i(x,y)$ is of size $M \times N$. In the training images, the active portions are manually labelled to extract the shape model parameters and appearance model parameters. A vector of X_{ij} and Y_{ij} : $j = 1,2,\cdots,N_p$ are generated in which the x and y co-ordinates are placed. Let N_p be the active portion of an image so that the vectors X and Y should follow the below criteria:

$$|X|_{ij} = |Y|_{ik} : j = k \quad (1)$$

$$|X|_j = (or) \neq |Y|_k : j \neq k \quad and \ k = 1,2,\cdots N_p \quad (2)$$

The grey portions of I_i are extracted using the X_i and Y_i as follows:

$$G_{ij} = \begin{cases} g_i(x,y) \ ; if \ x \leq X_{ij}(k) \, and \ y \leq Y_{ij}(k) \\ 0; \qquad otherwise \end{cases} \quad (3)$$

where,

$$g_i(x,y) = 0.3I_i^R(x,y) + 0.6I_i^G(x,y) + 0.1I_i^B(x,y) \quad (4)$$

In Eq. (4) R, G and B indicates colour spaces (R-Red colour, G-Green colour, B-Blue colour). Then, appropriate normalization is applied over X , Y and G as follows:

$$\overline{X_j} = \frac{1}{N_I}\sum_{i=0}^{N_I-1} X_{ij}, \overline{Y_j} = \frac{1}{N_I}\sum_{i=0}^{N_I-1} Y_{ij}, \overline{G_j} = \frac{1}{N_I}\sum_{i=0}^{N_I-1} G_{ij} \quad (5)$$

such that,

$$\overline{X_j} = \overline{Y_j} \quad (6)$$

From X,Y and G, the shape and grey parameters are determined as follows:

$$A_{ij} = \begin{bmatrix} S_p^{(ij)} w_{ij} \\ G_p^{(ij)} \end{bmatrix} \quad \text{where} \quad S_p^{(ij)} = \begin{bmatrix} (\overline{X_j} - X_{ij})\xi_j^x \\ (\overline{Y}_j - Y_{ij})\xi_j^y \end{bmatrix} \quad \text{and} \quad G_p^{(ij)} = (\overline{G}_j - G_{ij})\xi_j^g \tag{7}$$

In Eq. (7) $\overline{X_j}$ is the normalized x and y coordinate vector value.

The obtained shape and grey parameters are subjected to decomposition to generate a vector of appearance parameters as follows:

$$A_{ij} = Q_{ij} a_{ij} \tag{8}$$

Where Q_{ij} and a_{ij} are eigenvectors and vector of appearance parameters, respectively.

3.3. The Recognition Phase

The recognition system compares the image parameters with the database images to recognize the authenticity of an image. However, the presence of image in the database ensures that the authenticity and the absence of images refuse to provide authenticity. Practically, the test image is subjected to shape and appearance parameter extraction in order to perform the recognition. The recognition system uses a similarity measure based distance; the formula below shows that and makes decision.

$$N_{test} = \sqrt{\sum_{x=0}^{M-1} \sum_{y=0}^{N-1} (I(x,y)^{original} - I(x,y)^{\text{model}}} \tag{9}$$

The output of decision making system is the person ID, if the subjected tested unknown image has an authenticity and Anonymous if malicious.

A. Database

The face image database that used in this work is based on CASIA Face Image Database and Property dataset contains 50 images from 5 persons. CASIA Face Image Database Version 5.0 contains 2,500 color facial images of 500 subjects. However, the face images of CASIA-FaceV5 are acquired using Logitech USB camera. The volunteers of CASIA-FaceV5 include workers, waiters, graduate students, etc. All face images are of 16 bit color BMP files with image resolution 640*480. Typical intra-class variations include pose, eye-glasses, illumination, imaging distance, expression, etc. Basically, we partitioned five different datasets from the

CASIA database, for experimentation in which each dataset has images of 100 persons at five different environments of illumination variations and poses. Figure 1 shows an example of CASIA face image that have been used in this work.

Figure (1) CASIA Face Image Example

B. Experimental Results

The proposed face recognition system is experimented in the working platform of MATLAB 7.12 with the system configuration, i5 CPU @ 3.19 GHz with 4GB RAM and evaluation is done using CASIA-Face V5 database and property dataset. From CASIA database, we partitioned five different datasets for experimentation in which each dataset has images of 100 persons at five different environments of poses and illumination variations and 50 images for 5 persons in the property dataset.

The performance of the technique is analysed by conducting n-fold (for our dataset, n = 10) cross validation over each datasets and the corresponding statistical performance measures are determined. To perform n-fold cross validation, ten folds of training and testing datasets are generated by folding operation. The cross validation results for 1: N recognition over five datasets are tabulated in Table 1-5,

Table 1: Cross Validation Results for CASIA Dataset in terms of Accuracy, Sensitivity, and Specificity

Cross Validation Rounds	Accuracy	Sensitivity	Specificity
1	90	90	88
2	92	89	89
3	99	100	89
4	93	100	99
5	90	94	87
6	94	95	100
7.	92	100	68
8	99	100	100
9	89	99	97
10	100	100	87

Table 2: Cross Validation Results for Property Dataset in terms of Accuracy, Sensitivity, and Specificity

Cross Validation Rounds	Accuracy	Sensitivity	Specificity
1	88	88	99
2	85	87	99
3	87	76	88
4	100	89	98
5	78	88	86
6	87	100	98
7	86	89	100
8	87	90	78
9	85	88	89
10	89	96	85

C. Conclusion

In this paper, a face recognition system is proposed by based on an enhanced AMM based features. The performance of the technique is analyzed in CASIA-face database, version 5 and property dataset. The recognition is evaluated by experimenting 1: N face recognition problem. The experimental results proved all the aforesaid features and benefits of the proposed technique with statistical measures. Moreover, the graphical illustration of the proposed face recognition method shows that the recognition process is efficient.

References

[1] Reza Ebrahimpour, Ahmad Jahani, Ali Amiri and Masoom Nazari, "Expression-Independent Face Recognition Using Biologically Inspired Features", Indian Journal of Computer Science and Engineering, Vol. 2 No. 3, pp. 492-499, 2011

[2] Sudhir Kumar and Saoni Banerji, "Face Recognition Using K2DSPCA",In Proceedings of the International Conference on Information and Network Technology, Singapore, Vol. 4, pp. 84-88, 2011

[3] Patil, Kolhe and Patil, "2D Face Recognition Techniques: A Survey", International Journal of Machine Intelligence, Vol. 2, No. 1, pp-74-83, 2010

[4] Mini Singh Ahuja and Sumit Chhabra, "Effect Of Distance Measures In Pca Based Face Recognition", Vol. 1, No, 2, July 2011

[5] Hua Gao, Hazım Kemal Ekenel, Mika Fischer and Rainer Stiefelhagen, "Boosting Pseudo Census Transform Features for Face Alignment", In Proceedings of BMVC, Dundee, pp. 1-11, 2011

[6] Dinesh Govindaraj, "Application of Active Appearance Model to Automatic Face Replacement", Journal of Applied Statistics, 2011

[7] Patrick Sauer, Tim Cootes and Chris Taylor, "Accurate Regression Procedures for Active
Appearance Models", BMVC, pp. 1-11, 2011
[8] Thorsten Gernoth, Andre Gooßen and Rolf-Rainer Grigat, "Face Recognition Under Pose Variations using Shape-Adapted Texture Features", In Proceedings of IEEE International Conference on Image Processing, Hong Kong, 2010
[9] Thorsten Gernoth, Katerina Alonso Martinez, Andre Gooßen and Rolf-Rainer Grigat , "Facial Pose Estimation using Active Appearance Models and a Generic Face Model", In Proceedings of the Fifth International Conference on Computer Vision Theory and Applications, Angers, France, Vol. 2, pp. 499-506, 2010
[10] Rabiul Islam and Fayzur Rahman, "Feature and Decision Fusion based Facial Recognition in Challenging Environment", IJCA Journal, Vol. 6, No. 1, pp. 30-35, 2011

