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Research Article

FACE RECOGNITION: DEALING WITH EXPRESSION VARIATIONS

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ABSTRACT

Face Recognition is integral part of biometrics. It has been a fast rising, challenging and attention-grabbing area in real time applications i.e. image analysis, pattern recognition, etc. Facial expressions is one of the most critical sources of variations in face recognition, especially in the common case where for enrollment only a single sample per person is existing. For a consistent authentication system, methods that improve the accurateness in the occurrence of such variations are still required. In this paper, we deal with this problem with an analysis by-synthesis-based method in which a number of synthetic face images with different expressions are formed. For this purpose, 3D mask is generated for each user based on respective landmark points. The role of these extra images in terms of the recognition performance is evaluated with different techniques on face recognition magnificent challenge and Bosphorus 3D face databases. The project is implemented using more than one sample of expression for a single person to get more accuracy in face recognition.

INTRODUCTION

Being the most commonly used biometric trait by humans, face recognition has become an active research topic for many decades now. Face recognition is such a demanding and interesting problem. So that it has paying attention to researchers from different backgrounds: psychology, pattern recognition, neural networks, computer vision, etc.

Biometric-based technologies include identification based on physiological characteristics (such as face, finger geometry, fingerprints, hand geometry, hand veins, retina, palm, iris voice and ear) and behavioral traits (such as gait, keystroke dynamics and signature) [1].

The first footstep in face recognition system is to spot the face in an image. To discover whether there are any faces in the image or not is the most important goal of face detection. Pre-processing is done to eliminate the noise and dependence on the exact registration. Face detection is the procedure to identify location and presence of facial appearance such as eyes, nose, lips, etc. Face detection and feature extraction is takes place at the same time. In face recognition, the query image is compared with database file. Then its output is match report and classification is approved out to identify the new observation. Face recognition is used for two prime responsibilities

Verification :- (one-to-one matching)

When presented with a face image of an unknown individual along with a claim of identity, ascertaining whether individual is who she/he claims to be.

Identification :- (one-to-many matching)

An image of an unknown individual is given and by comparing that image with a database of images of known individuals for determining that person's identity.

In order to improve the recognition performance of these methods [2, 3, and 4], face recognition is also being used in combination with other biometrics such as speech, ear, fingerprint, and iris and gait recognition. To recognize the exact person is the central mean of face recognition from video or pictures via databases of face images. Three steps in face recognition system are face detection, feature extraction, and classification [7] respectively.

Four modules used in biometric recognition system: (i) Image captures of a biometric trait (ii) Feature extraction module that extracts certain features from the biometric data (iii) System

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database which is used to store the features extracted from biometric data. (iv) Matcher module that matches the features extracted from the biometric imputed data and the features already stored in the system database.

Furthermore face recognition methods classify as,

Feature – based Approach

Extraction of geometric features such as position and width of nose, eyes, and mouth eyebrow's thickness, takes place. In this feature –based method to characterize a face. Like facial features supplementary fiducial marks are also extracted and then among those facial points they compute geometric relationship. Appearance based method is much better, because it gives better results than feature based method [1].

Holistic Approach

Global information from faces is utilized in holistic face recognition to execute face recognition which is represented by a few features which are directly resulting from the pixel information. This small number of features clearly captures the difference among different individual faces [2]. Whole face is taken as an input in this holistic approach to perform face recognition. Holistic approach concentrate on only limited regions or points of interest without destroying any other information in images. Combination of feature based approach and holistic approach is known as Hybrid approach, where both whole and local face is used as input to face detection system.

LITERATURE SURVEY

Over years several works have been introduced for the face recognition. There are different methods used in face recognition. Generally most of the methods are based on Principal Component Analysis.

L. D. Introna and H. Nissenbaum[1], proposed, "Facial recognition technology: A survey of policy and implementation issues" which develops a socio-political analysis that bridges the technical and social-scientific literatures on FRT and addresses the unique challenges and concerns that attend its development, evaluation, and specific operational uses, contexts, and goals.

It highlights the potential and limitations of the technology, noting those tasks for which it seems ready for deployment, those areas where performance obstacles may be overcome by future technological developments or sound operating procedures, and still other issues which appear intractable. Its concern with efficacy extends to ethical considerations.

A. F. Abate, M. Nappi, D. Riccio, and G. Sabatino[2], proposed"2D and 3D face recognition: A survey,". It is nothing but the survey done on the face recognition technique based on 2D and 3D database.

J. P. Phillips, P. Grother, R. J. Michaels, D. M. Blackburn, E.Tabassi, and M. Bone [3], proposed "FRVT 2002 evaluation report," in which FRVT 2002 demonstrated that using 2D intensity or color images, a recognition rate higher than 90 % could be achieved under controlled condition.

J. P. Phillips [4], studied that performance of face recognition was achieved in FRVT 2006 over the FRVT 2002 for 3D face images, with FRR of 0.01 and FAR of 0.001.

W. Y.Zhao and R. Chelappa [5], proposed shape-from-shading(SFS) based method to generate synthetic facial images under different rotations and illuminations.

X. Lu, R-L.Hsu, A. K. Jain and B. Kamgar-Parsi [6], proposed Current appearance-based face recognition system encounters the difficulty to recognize faces with appearance variations, while only a small number of training images are available.

Y. Hu, D. Jiang, S. Yan, L. Zhang, and H. Zhang [7], proposed an analysis-by-synthesis framework for face recognition with variant pose, illumination and expression (PIE).

M. W. Lee and S. Ranganath [8], proposed a pose-invariant face recognition system which is based on a deformable, generic 3D face model. This model is a composition of an edge model, a color region model and a wireframe model and also used to describing the shape and important features of the face.

J. Huang, B. Heisele, and V. Blanz [9], proposed a novel approach to pose and illumination in- variant face recognition that combines two recent advances in the computer vision held: component-based recognition and 3D morphable models.

U. Prabhu, J. Heo, and M. Savvides [10], proposed a 3D model reconstruction by applying the 3D generic elastic model approach. Instead of enlarging the training set, they choose to estimate the pose of the test query and render the constructed 3D models at different poses within a limited search space about the estimated pose.

V. Blanz and T. Vetter [11], proposed a morphable model that is based on a vector space representations of faces is constructed from 3D scans of 100 males and 100 females. After dense correspondences are established between the scans, Principal Component Analysis is performed on the shape and texture vectors resulting in two orthogonal bases formed by 90 eigenvectors. During the fitting process, the shape and texture coefficients together with illumination parameters are estimated iteratively to bring the morphable model as close as possible to the query image. Finally two faces are compared by the set of coefficients that represent shape and texture using Mahalanobis distance.

METHODOLOGY

The Block diagram of face recognition technique is given as below in fig. Into the block diagram flow of the work is given into one after one. In this system, we are using Bosphorus 3D database for enrollment. Here we have taken few person's different facial expressions. The obtained 3D facial surface together with the registered texture is preprocessed, scanner-induced holes and spikes are cleaned and a bilateral smoothing filter is applied to remove white noise while preserving the edges to get noise free face model.

As database is too large in size, it takes too much time for the preprocessing only. We can think that only preprocessing takes that much time to proceed then further more processes being

gets more delayed to execute. So that it will very time consuming process. To avoid this, we already preprocessed that facial images. Then some of that preprocessed images are given to training set and remaining images are given to testing set. After that we have taken one of the image from testing set that means the image which is not present in training set and then applied as a input to the system for further processing of face recognition. 22 feature points are automatically detected using either shape, texture or both, according to the regional properties of the face. These detected points are then used to warp a generic animatable face model. So that it completely transforms into the target face.

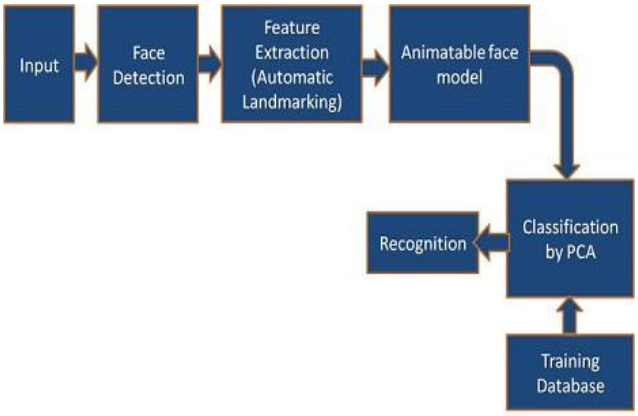

Fig. 1:- Block Diagram

Input images

Here already preprocessed facial images have taken as input to the system. These images are noise and hole free and also in the gray format. There are near about 38-40 different types of facial expressions per person are available. From that some of images are given to training set and remaining are given to testing set. We can take one of the image from that testing set as a input.

Face Detection

Face detection is the process to extract only face part from input image which has normalized intensity and uniform in shape and size. The appearance features describes changes of faces. It detects face and ignores anything else. Firstly feature outlining is done and then face is detected using available information present in database. Voila johnes face detector is used for the face detection.

Automatic Landmarking

For this, we aim to extract a subset (22 points) of input image Facial Definition Parameters (FDPs) to be used for the alignment of the faces with the animatable generic model. For the extraction of the points, 2D and/or 3D data are used according to the distinctive information they carry in that particular facial region.

Firstly, facial midline (vertical profile) analysis is done and 5 fiducial points on that midline are detected. Based on that information; face is split into sub-regions for the coarse localization of eyes, nose and lips. After that, further analysis is done inside these extracted sub-regions to detect the points of interest. For those regions with non-informative texture (like nose), 3D data is analyzed. On the other hand for the regions with noisy surface and/or distinctive color information (like eyes), 2D data is utilized. As a result, 22 facial interest points are detected in total, consisting of 5 points for each eye, 5 points for the nose and 6 points for the lips (Fig. 4). Total 22 points are used for the construction of animatable face model to properly align the generic face to target face. As we done the point localization on 2D, then we can easily locate corresponding points on 3D.

Constructing the Animatable Face Models

A mesh warping algorithm based on the findings is used to construct an animatable face model for each enrolled subject. In database bnt files are already exists and raw scanner data 3D is also available from database. After that meshing is done. A plot of 3D points is made which is nothing but an image. This is process of 3D mask generation. Then corresponding facial points are located on that face model respective of 2D plot. A generic face model, with holes for the eyes and an open mouth is strongly warped to fit the facial models in the database

Classification by PCA using Eigen Face

To recognize new face, other than gallery images, we are going to perform a classification by PCA using Eigen face. This is the method for face recognition which uses a nearest neighbor classifier or we can say that it finds the closest match to a face class. PCA is applied for face recognition by converting the pixels of an image into a number of eigenface feature vectors, which can then be compared to measure the similarity of two face images. For that we have to calculate the eigen vectors of all training images and its mean value which gives us eigen value. Then find out the feature of input image and also eigen vector using principal component analysis. Subtract mean from that of input image, which gives us an eigen vector. Next step is to calculate the Euclidean distance between their corresponding feature vectors. The feature vectors which have smaller distance than all other between them, that is the more similar to the face. Hence right person is detected and also recognized. PCA used for dimensionality reduction and it gives good result.

RESULTS

The obtained results are shown in figure below. The images have been taken from 3D Bosphorus database. Different face images with different expressions are taken. In these MATLAB window, Fig. 2 shows the input image applied to system which is taken from testing set. That image is already preprocessed. Then feature outlining is done as shown in fig.3. Next is cropped image which detects only face part using voila johns face detector. It extracts only face region and ignores anything else as shown in fig.4. After that in fig.5 face part separation is done. It separates the eyes, nose and lip region and only skin region is cropped. Fig.6 shows the result of automatic landmarking on 2D plot. For this we have extracted 22 facial feature points using vertical profile analysis. For the extraction of the points, 2D and/or 3D data are used according to the

distinctive information they carry in that particular facial region. Then fig.7 shows the animatable face model. In this face model, 3D feature points are located corresponding to that of 2D feature points. And last figure is nothing but the result of our face recognition method. Fig.8 shows recognition result. Recognition is done by principal component analysis using eigen vector. It shows that the person whose one of the expressional image is given as a input for detection and recognition.

Fig.2

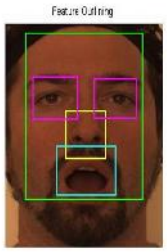

Fig.3

Fig.4

Fig.5

Fig.6

Fig.7

Fig.8

CONCLUSION

The basic goal of proposed method is to extract robust features for face recognition for identification. In this paper we have presented a structure of face recognition using 3D database. We have also obtained results on 3D face recognition designed to handle different expression variations, pose variations and occlusions between gallery and query image.

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