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Progression in large Age-gap face verification

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Abstract - *Human face verification is an important topic in computer vision, imaging and multimedia as it defines the uniqueness and conveys ones identity. Recognition of face or identity is required to access the rendered services by the licit person only. Applications include access to computer system, ATMs, laptops, mobile phones etc. Verification accuracy might get failed if it encounters any of the factors listed as variation in face pose, facial expression, illumination and aging. This survey paper presents panoramic view of progression in face recognition right from the conventional methods to the most advanced technologies (i.e. Deep neural network). Applications in different field such as security, machine recognition of faces in non law enforcements (like passports, photo IDs, driving licenses) has been mentioned. It also showcases the framework (parameters, techniques, database, machine learning techniques etc)*

Key Words: Face recognition, Illumination, Data set, Auto-encoder, deep neural network

1. INTRODUCTION

The human face plays an important role in our social interaction, conveying people's identity. Using the human face as a key to security, machine recognition of faces is emerging as an active research area spanning several disciplines such as image processing, pattern recognition, computer vision and neural networks. Biometric face recognition technology has received significant attention both from neuroscientists and from computer vision scientists in the past several years due to its potential for a wide variety of applications in both law enforcement and non-law enforcement such as passports, credit cards, photo IDs, driving licenses and mug-shots to real time matching of surveillance video images.

As compared with other biometrics systems using fingerprint, palm print and iris, face recognition has distinct advantages because of its non-contact process. Face images can be captured from a distance without touching the person being identified and the identification does not require interacting with the person. In addition, face recognition serves the crime deterrent purpose because face images that have been recorded and archived can later help identify a person. Research interest in face recognition has grown significantly in recent years as a result of the following facts:

1. The increase in emphasis on civilian or commercial research projects.
2. The increasing need for surveillance related applications due to drug trafficking and terrorist activities etc.
3. The re-emergence of neural network classifiers with emphasis on real time computation and adaptation.
4. The availability of real time hardware.

Facial biometric is used to verify the identity of individuals attempting access for various border management and access control applications. Facial matching algorithms make use of digital photographs of the face stored in a database or on an ID card. These digital images are captured upon registration into the system and then compared to the live photo of the individual upon an access attempt in a process called "matching". Face recognition is an easy task for human experiment; the three day old baby is able to distinguish among known faces. Facial recognition utilizes distinctive features of the face including the upper outlines, the eye sockets, the areas surrounding the cheekbones, the sides of the mouth, the location of the nose and eyes to perform verification and identification. Each method that involves with the face recognition has the similar chain of steps as collection of images (dataset), image pre-processing that followed by alignment of images, face detector then feature extraction that includes dimensional reduction and finally imparting training in deep neural network for classification and identification.

2. LARGE AGE-GAP FACE IDENTIFICATION SYSTEM

Age invariant recognition system primarily comprises of the following stages image source that provides the individuals picture to be recognized, face detection, face normalization, image pre-processing, feature extraction and then feature matching for image identification. Figure 1 illustrates the stages involved in any age invariant face recognition system.

A. Image source

It can be the digital camera or smart phones that can provide the image. CCTV cameras are also deployed for capturing images and videos and later can be used to provide the source for image.

B. Face detection

This phase of system finds the face region of the image. The most popular face detector is Viola-jones and Face-vecs. It tries to locate the facial landmarks using face alignment algorithm. It uses the eye locations to align the photo so that eyes are horizontally aligned for detecting the face. Detection error could influence normalization result.

C. Face normalization

It prepares the image for feature extraction phase of the system. It reduces the intra-class differences but not affect the extra-class variations. It enhances the visual effects of the image and hence subsequently improves recognition performance. It assesses the betterment of following recognition stages. The main objective behind the face normalization is to reduce the useless and redundant information that it carries.

D. Feature extraction

Feature extraction is the most crucial stage for face recognition as it stands out to be the base for extracting the relevant information from the picture or image. There are multiple of feature extraction method available viz. local binary pattern (LBP), Histogram of oriented gradients (HOG) etc.

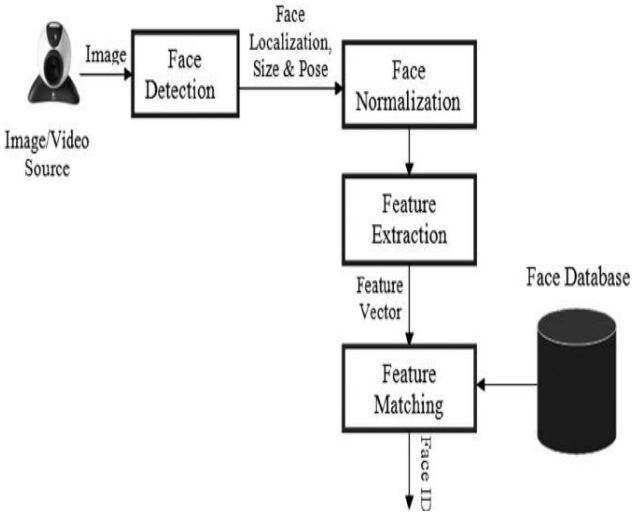

Fig -1: Block diagram of age invariant face recognition system

3. LITERATURE SURVEY

In 1991, the M. Turk et al [1] proposed the simplest approach of template matching. It was a 2D approach and unsupervised learning. Here the face images are projected onto a feature space that encodes the variation among known face images but the drawback that lies with these Eigen-faces is that the training images must be centered and of the same size but it is considered to be the easiest to implement. The idea behind Eigen-faces is to map data into a lower dimensionality space. Its performance limits with the change of illumination. Person is being recognized by comparing characteristics of the face image with the Eigen-faces of the training set of face images. Its idea is to find principal component of the distributions of face.

After few years in 1997 Peter N. Belhumeur et al [2] developed the face recognition procedure that works with large variation in lighting direction and facial expression. Pattern classification approach has been used where each pixel of an image considered as a coordinate in a high dimensional space. A derivative of Fisher's Linear Discriminant (FLD) a class specific linear projection is used. It compared various methods of pattern classification i.e correlation, Eigen faces and Fisher's Linear Discriminant (FLD). FLD proved to be the best classification technique among all as it stood against the sensitivity under lighting conditions and also needed less storage.

In 2010 Unsang Park [3] proposed the conversion of 2D face aging dataset to 3D aging model. It worked on building the 3D aging model provided the availability of 2D face aging dataset. It considered the separate modeling of shape and texture followed by final matching done by face VACS face matcher.

With advancement in time some new concepts coined up like hidden factor [4] proposed and developed by Dihong Gong et al. in 2013 stated that the face can be decomposed into identity factor that remains unaffected with age and an age factor affected by the aging process. Local face descriptor Histograms of Oriented Gradients (HOG) is applied followed by the dimensional reduction techniques i.e. PCA and LDA to get smaller sliced vector for further analysis. The two dataset used here are MORPH and FGNET. Identification rate of 91.14% is obtained with MORPH and 69.0% with FGNET databases. This linear model clearly defines the boundary between the identity factor and age factor. It has the Noise factor that leads to the deviation from the model parameters.

Guosheng Hu et al [5] in this work they conduct a rigorous experiment on LFW data set. They conducted experiments on three different CNN architectures CNN-S (small), CNN-M (medium) and CNN-L (large). They used the metric learning method i.e. Joint Bayesian model that makes the two classes more separable with the activation function being used here is rectification linear unit (ReLU). CNN and metric learning highly increases the success rate of the face recognition system.

Dihong gong et al [6] in 2015 described the encoded maximum entropy of images microstructures into discrete codes followed by the identity factor analysis for estimation of identity of two similar faces. MEFD is used as the feature descriptor followed by the dimensional reduction technique

PCA and LDA and then identity factor analysis has been done for classification. The datasets used were MORPH and FGNET. Easy implementation and clubbing with any feature descriptors for further improved recognition is the merit. This cannot be directly applied on the dataset that don't belong to face aging.

Another application of deep neural network that worked with the CAFÉ dataset has been successfully presented by Luoqi Liu [8] et al included the DAFV framework that perfectly described the aging pattern followed by the aging face verification.

One of the recent fine works has been presented by Simone Bianco [12] in 2016 that successfully coupled two DCNN in a Siamese architecture with a contrastive loss function and it outperformed the existing methods.

4. FACE RECOGNITION APPROACHES

There are different face recognition methods. Here the relative survey of performances of three techniques – feature, soft computing and appearance is stated below and is shown in figure 2.

A. Feature based face recognition approach

It utilizes a previous face data to pick a feature quantity to completely recognize people. Local features are eyes, chin, nose, head and mouth outline which can be decided from images of face. Topological graphs in fig 1.3 are utilized to show associations among features that achieve structure which is utilized to differentiate associated faces from a database. Feature based approaches handles problem of diverse radiance situation, scaling, facial expressions, noisy images, face occlusions and aging effects. Some of the prominent advantages shown by this method are

- From face images it accurately captures relevant features.
- Insensitivity to face orientation, variable lighting and size situations.

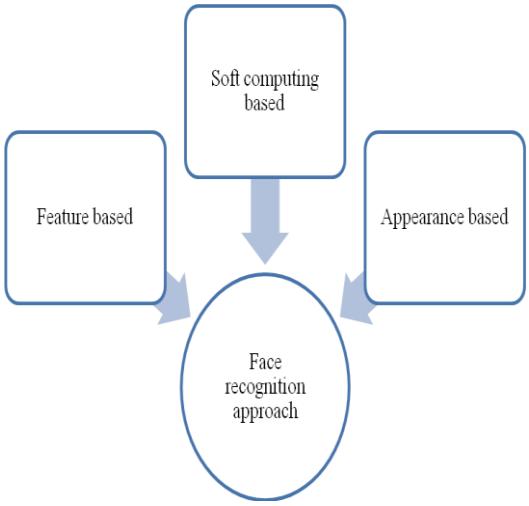

Fig -2: Different types of face recognition approaches

B. Soft computing based face recognition approach

This technique has appeared as a significant technique for examination in computer vision investigation. This technique enhances the processing speed of face recognition system. Neural network is trained on the same pictures and databases again and again which in turn makes the system more efficient and reliable. Non linear functions or the problems can be solved where the mathematical models are not available. It can process easily with big size features. Somehow this technique is costly and need a great correlation degree among test and training pictures. Soft computing FR technique can be categorize again in three domain as illustrated

- Artificial neural network (ANN) based methods: it is an effective tool to resolve non-linearity executed with the aid of specific constraints. It gives the best decision making schemes which can be trained to perform complicated applications like pattern recognition (PR), classification optimization and identification. It has the capability to study from any undetected information. It is also free from any fault in its any node.
  It holds few limitations also it takes large computation time to train data.

- Fuzzy based technique: fuzzy logic is utilized for modeling human intelligence and awareness. It is used in rigorous face recognition framework. It is unresponsive to fluctuating lighting and facial expressions. It delivers good output only for minor variation in facial expressions and illumination.

- Genetic algorithm (GA) based technique: GA is proficient in decreasing calculation time for a massive heap space. GA is a technique that works on finding fittest and optimized solutions from a given population. It works well with huge dataset.

C. Appearance based face recognition approach

Appearance based FR methods have obtained good interest from a large variety of examination fields which includes biometrics, pattern recognition and computer vision. There are basically two types involved in appearance based FR and they are as holistic method and hybrid technique. It handles the problem of pose variations, facial expressions numerous lighting situations and small resolution. It holds advantages like dimensionality decrease and improved recognition output. It is sensitive to face orientation, noise and size. Examples of appearance based FR methods are Eigen faces, DFT etc.

- Holistic method: it makes use of complete face area as raw input to a recognition device. One of the greatest broadly utilized face area representations is Eigen image. Machine recognition framework is ought to utilize only face. Eigen faces and Fisher faces had appeared to be operative in tests with bigger databases. Key benefit of holistic method is that they don't destroy any of records within picture and concentrates only on limited areas only. On the contrary, it needs high computational cost.

- Hybrid method: this method utilizes holistic and local features both. Idea of Eigen faces are extended to Eigen structures for instance Eigen mouth, Eigen eyes etc.

5. CHALLENGES INVOLVED

Face recognition technique is highly affected by the challenges it faces in its path. Technologies are somewhat resistant to moderate changes in hairstyle, as they do not utilize areas of the face located near the hairline. When used to identify the person's image it may return or generate the wrong results. Here are some of the factors that lead to the undesired results.

- TEMPORAL INVARIANCE

It is one of the challenges which are to be achieved and the aim is to get the representation and matching method that remains unchanged due to facial aging. The performance of facial recognition technology is very closely tied to the quality of the facial image. Low-quality images are much more likely to result in enrolment and matching errors than high-quality images.

- FACIAL AGING

Headings, or heads, are organizational devices that Facial aging is a growth process where the 3D shapes of the face and its texture changes which surely degrade the matching performance of the system.

- OCCLUSION

Occlusion in image is broadly defined as the hidden information or the part of the image that cannot be clearly stated or shown. Example a car passing under the bridge.

- ILLUMINATION

This reflects the brightness and contrast of image and is a major factor that sometimes hinders in the recognition of the image.

REFERENCES

[1] M. Turk and A.Pentland, "Eigenfaces for Recognition", Journal of Cognitive Neuroscience, vol.3, no.1, pp. 71-86, 1991, hard copy

[2] Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection article in IEEE Transactions on pattern analysis and Machine Intelligence. July 1997

[3] U.Park, Y.Tong, and A.K. Jain,"Age-invariant face recognition," pattern analysis and Machine intelligence IEEE Transactions on, vol 32. No.5.pp 947-954.2010.

[4] D. Gong, Z. Li, D.Lin, J. Liu, X. Tang, "Hidden Factor Analysis for Age Invariant Face Recognition". ICCV 2013

[5] Guosheng Hu, Yongxin yang, Josef Kittler, "When face recognition meets with Deep learning: an evaluation of convolutional neural networks for face recognition". April 2015

[6] Dihong gong, Zhifeng Li and Dacheng Tao, "A maximum entropy feature descriptor for age invariant face recognition", in 2015.

[7] FG-NET Aging Database, http://www.fgnet.rsunit.com/.

[8] L.Liu, C.Xiong, H. Zhang, Z. Niu, M. Wang and S. Yan, " Deep aging face verification with large gaps," Multimedia, IEEE transactions on , vol.18, no.1, pp. 64-75, 2016.

[9] Y. Taigman,M. Yang, M. Ranzato, and L. Wolf, "Deep face closing the gap to human-level performance in face verification,"in proceedings of the IEEE Conference on computer vision and pattern recognition, 2014,pp. 1701-1708

[10] Timo Ahonen, Abdenour Hadid, and Matti "Face descriptions with local binary patterns: Application to face recognition," IEEE Trans. Pattern Anal. Mach. Intell vol. 28, no. 12, pp. 2037-2041, 2006.

[11] Jiaji huang, Qiang Qiu, Robert Calderbank and G. sapiro, "Geometry aware deep transform", ICCV 2015

[12] Simone Bianco, " Large age-gap face verification by feature injection in deep networks," in 2016