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Face Verification across Age Progression with Wavelet Transforms: A Review

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Abstract

In human faces, a lot of change in the appearance is seen as their age is increased. In order to recognize faces which are under varying illumination, we have proposed a wavelet-based normalization method so as to normalize the images. This method will normalize the face for extracting and matching the images with the stored images in the database. In this research paper for normalizing the image we are using discrete wavelet transform (DWT) and for matching the images with the stored image we are using minimum distance feature vector algorithm and template matching method. It will calculate the matching percentage of the original image with the new image. Again, the proposed research work for this paper is to compare the matching percentage with the wavelet transform and the minimum distance feature vector algorithm. For taking the dimension of that image again we are using the Gradient Orientation Pyramid and Support Vector Machines (SVM's).

Keywords:-Template Matching Method, DWT, Feature Vector Algorithm, Gradient Orientation Pyramid

1. Introduction

Face verification is an important problem in the field of computer vision and has a very wide range of applications, such as surveillance, human computer interaction, image retrieval etc. Facial recognition systems are computer-based security systems that are capable of automatically detecting and identifying the human faces. The system is mainly dependant on a recognition algorithm, such as eigen face or the hidden Markov model. The first step for a facial recognition system is to recognize a human face and extract it from the rest of the scene. Next, the system measures the nodal points on the face, such as the distance between the eyes, the shape of the cheekbones and other distinguishable features. These nodal points are then compared to the nodal points which are computed from a database of pictures in order to find a match. New technologies that are currently in development to create three-dimensional models of a person's face which are based on a digital photograph in order to create more nodal points for comparison. However, such technology is inherently susceptible to the error given that the computer is extrapolating a three-dimensional model from a two-dimensional photograph. Some of the interesting applications of studying the age progression in the human faces are discussed as below:

[1] Developing face recognition systems that are robust to age progression which would enable the successful deployment of face recognition systems in public places. Such systems would be highly beneficial to homeland security applications. Further developing systems that will verify the face images across age progression.

[2]Since different individuals age differently, developing automatic age progression systems that could predict the many different ways a person could have aged would have a significant impact in finding missing individuals.

The changes in facial appearances are attributed to have a significant psychological impact on an individual. There are numerous applications for face recognition technology.

1.1. Government Use:

1.1.1. Law Enforcement:
Minimizing victim trauma by narrowing mugs hot searches, verifying identity for court records and comparing the school surveillance camera images to the known child molesters.

1.1.2. Security/Counterterrorism:
Access Control, comparing the surveillance images to the known terrorists

1.1.3. Immigration:
Rapid progression through customs.

1.1.4. Legislature:
Verify the identity of congressman prior to vote.

1.1.5. Correctional Institutions/Prisons:
Inmate tracking, Employee access

1.2. Commercial Use:

1.2.1. Day Care:
Verify the identity of individuals picking up the children

1.2.2. Missing Children/Runaways:
Search surveillance images and the internet for missing children and runaways, gaming industry find card counters and thieves, Internet, E-Commerce.
For the compression of images in this research work, we are using DWT (Discrete Wavelet Transform) technique. But how this flow can be done is given as below:

2. Wavelet Compression (DWT)

For the compression of images we are using the normalization technique that comes under the category of wavelet transform. The compression of the image is done with the following flow:

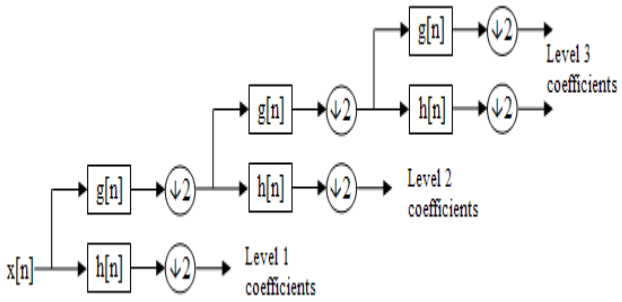

Figure 2 Discrete Wavelet Transform (DWT)

Discrete Wavelet Transform can be described as a series of filtering and sub sampling (decimation in time) as depicted in Figure 1. In each level in this series, a set of 2j-1 coefficients are calculated, where j < J is the scale and N = 2J is the number of samples in the input signal. The coefficients are calculated by applying a high pass wavelet filter to the signal and down sampling the result by a factor template images. The changes are due to the illumination variation of 2. At the same level, a low pass scale filtering is also performed (followed by down sampling) in order to produce the signal for the next level. Both the wavelet and scale filters can be obtained from a Quadrature Mirror Filter (QMF) function that defines the wavelet.

3. Support Vector Machines (SVM's)

The SVM is divided into two parts: Linear SVM and Non-Linear SVM. In linear SVM most "important" training points are the support vectors, they define the hyper plane. Quadratic optimization algorithms can identify which training points x_i are the support vectors with non-zero Lagrangian multipliers α_i. Both in the dual formulation of the problem and in the solution training points appear only inside dot products. In Non-Linear SVM, the SVM locates a separating hyper plane in the feature space and classify the points in that space. It does not need to represent the space explicitly, simply by defining a kernel function. The kernel function plays the role of the dot product in the feature space. The SVM is used to divide the feature space into two classes, one for inra-personal pairs and the other for extra personal pairs. By using the same terminology, we denote the separating boundary with the following equation:

$$\Sigma_{i=1}^{XN's} a_i y_i K(s_i, x) + b = \Delta \quad \ldots\ldots \quad \text{Eqn. (1)}$$

where N's are the number of support vectors and s_i is the i-th support vector, is used to trade off the correct reject rate and correct accept rate as described in (3) and (4). K is the kernel function that provides the SVM with non-linear abilities. For verification tasks, the correct reject rate (CRR) and the correct acceptance rate (CAR) are the two critical criteria. Here the correct reject rate and the correct acceptance rate is calculated with the help of following formulas:
CRR = # correctly rejected extra-personal pairs/#Total extra-personal pairs
CAR = # correctly accepted intra-personal pairs/#Total intra-personal pairs
where "accept" indicates that the input image pairs are from the same subject and "reject" indicates the opposite. In addition, the equal error rate (ERR), which is defined as the error rate when a solution has the same CAR and CRR, is frequently used to measure the verification performance [1].

4. Edge Gradient Representation (GOP)

One of the problems which is occurring when we are using the gray scale value of image for object matching is the changes in illumination can significantly reduce the correlation between the test and is difficult to predict without a priori model of the object which is under consideration. It has been observed that as compared to gray scale values, the edge maps are more robust to illumination variation [6]. The edge maps are obtained by computing the intensity gradients and thresholding the gradient values. The selection of the threshold value is low, then the spurious edges come up in the edge map. On the other hand, a high threshold value can obliterate significant edges. Another problem in using the edge map for correlation is that even a small deformation in the edge contours can significantly reduce the correlation. For finding the gradient of a particular image, we will be taking help of the following formula:

$$\Delta f = \delta f/\delta x + \delta f/\delta y \quad \ldots\ldots \quad \text{Eqn. (2)}$$

where $\delta f/\delta x$ is the gradient in the x direction.
$\delta f/\delta y$ is the gradient in the y direction.

5. Proposed Method for Matching Face Images Across Aging

Figure 2 shows a schematic of the proposed non-generative approach for face verification across age progression. We now present the results of the

experiments which are performed to evaluate the effectiveness of the proposed method. In this analysis, we deal primarily with the aging effects in adults and so we use a part of a private passport dataset which consists of age separated pairs of adult face images. In our experiments, we use 350 genuine pairs of images with average age separation of over 9 years. For this particular matching the face image in to the database we are using the minimum distance feature vector algorithm and with the help of that algorithm we can calculate the difference between the original image and the detected image. For finding the matches with the original image, we have to take the difference between the current image and the extracted image and after finding the difference; we have to take the sum of all the detected features for taking the average percentage of the images. For finding the difference following steps are implemented:

[1] Find the difference between the declared variable.
[2] Diffrence = absolute value of (current_variable – detected_variable)
[3] Diffrence_Sum = Sum of (diff)
[4] Then,put this sum inside the match error variable.
[5] Match_Percentage (count) = 100*(65536 – diff_sum)/65536
[6] Index (count) = count

The same proposed research work can be shown in the following block diagram:

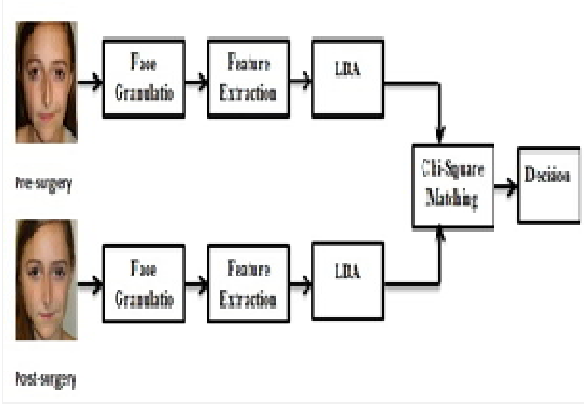

Figure 3 Block Diagram of Proposed System for Matching the Face Images across Aging

6. Conclusion

In this research paper, we studied the problem of face verification with age variation by using discriminative methods. Again in this research paper, we are only concentrated on the discriminative methods like GOP (Gradient Orientation Pyramid) and the Support Vector Machines (SVM's). In many previous works, they were doing their research work with the help of these two methods but the result is not getting in the normalized form, so for this reason we can use the wavelet transform for normalization. With the help of normalized images, we can detect the face for a particular image and then store that image in the database for matching of the feature vector. For face detection, we use the technique of conversion of RGB to YUV image. With the help of that technique, we detect the face and in the future work, we match the nodal points for that particular image and then store them in the database for the purpose of age verification.

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References

[1]. I. Craw, D. Tock and A. Bennett, "Finding Face Features", Proceedings of the 2nd Eurpean Conference on Computer Vision, pp. 92-96, 1996.
[2]. A. Lanitis, C.J. Taylor and T. F. Cootes, "An Automatic Face Identification System using Flexible Apperance Models", Image and Vision Computing, Volume 13, No. 5, pp. 393-401, 1995.
[3]. T. K. Leung, M. C. Burl and P. Perona, "Finding Faces in Cluttered Scenes using Random Labeled Graph Matching", Proceedings of the 5th IEEE International Conference on Computer Vision, pp. 637-644, 1995.
[4]. B. Moghaddam and A. Pentland, "Probabilistic Visual Learning for Object Recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume 19, No. 7, pp. 696-710, July 1997.
[5]. M. Turk and A. Pentland, "Eigenfaces for Recognition", Journal of Cognitive Neuroscience, Volume 3, No. 1, pp. 71-86, 1991.
[6]. M.Kirby and L. Sirovich, "Application of the Karhunen-Loeve Procedure for the Characterization of Human Faces", IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume 12, No. 1, pp. 103-108, January 1990.

[7]. Face Verification Across Age Progression Using Discriminative Methods, Haibin Ling, Member, IEEE, Stefano Soatto, Member, IEEE and David W. Jacobs, Member, IEEE.
[8]. Face Recognition 101 the Technology and its Applications, Duane M. Blackburn 1 August 10, 2001.
[9]. Genetic Search for Face Detection and Verification, George Bebist, Satishkumar Uthiramt and Michael Georgiopoulos S, Department of Computer Science, University of Nevada, Reno, Department of Electrical and Computer Engineering, University of Central Florida {bebis, uthirams}@cs.unr.edu, mng@ece.engr.ucf.edu
[10]. Multi-Resolution Local Appearance-Based Face Verification Hua Gao, Hazim Kemal Ekenel, Mika Fischer, Rainer Stiefelhagen, Institute of Anthropomatics, Karlsruhe Institute of Technology, Karlsruhe, Germany e-mail: {hua.gao, ekenel, mika.fischer, rainer.stiefelhagen}@kit.edu
[11]. Wavelet-Based Illumination Normalization for Face Recognition, Shan Du and Rabab Ward, Department of Electrical and Computer Engineering, The University of British Columbia, Vancouver, BC, Canada {shand, rababw}@ece.ubc.ca
[12]. Novel Kernel Discriminant Analysis for Face Verification Georgios Goudelis, Stefanos Zafeiriou, Anastasios Tefas and Ioannis Pitas, Department of Informatics, Aristotle University of Thessaloniki, Greece.

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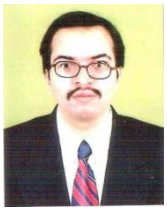

My name is **Prof. Abhinav V. Deshpande.** I have done M. Tech. in Electronics Engineering from G. H. Raisoni College of Engineering, Nagpur in the year 2012 with a CGPA of 7.90 on a scale of 10.00. I have also done B. E. in Electronics & Telecommunication Engineering from the same institute in the year 2010 with an aggregate of 63%. I have also passed the Ph. D. Entrance Test (PET) which was conducted by RTMNU in the year 2013 as well as 2015 with valid scores of 55 and 55.75 marks out of 100 respectively. I have also passed the Ph. D. Entrance Test (PET) which was conducted by Gondwana University, Gadhchiroli in the year 2015 with a valid score of 51 marks out of 100. I want to pursue Ph. D. as a future career option since I am genuinely interested in the field of research and development in the broad domain of Electronics Engineering. I have published 28 research papers in different and reputed International Journals and 1 research paper is presented in International Conference as well as published in the Conference Proceedings. I have also published 1 book in Saarbrucken, Germany and the name of the publishing group is Lambert Academic Publishing (LAP) House. I am also having memberships of 6 different and reputed Professional Organizations like ISTE, IE(I), IET, IETE, IEEE, UACEE.