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Developing an Intelligent Electronic System to Detect and Recognize a Human Face of the Employee Car Driver to Enter to the University of Tabuk

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Abstract: The ability to detect and recognize human faces is a key requirement in a great number of applications such as human tracking, human–computer interface, person identification for security systems and the surveillance of human activities. Much research effort has been directed towards this hot topic in recent years. This research project is building a system to detect and recognize a human face of the employee car driver to enter to the university of Tabuk. A system that uses a digital camera will be developed to capture and process the picture of the face driver. To recognize a face, face detection and recognition methods will be developed. The proposed system is composed of the following stages: 1) image acquisition 2) preprocessing methods 3) face detection 4) face recognition. The main goal of this research is to develop an intelligent system to detect and recognize a human face of the employee car diver to enter to the university of Tabuk.

Keywords: Feature Extraction, Gabor feature, Principal Component Analysis, Nearest Neighbor, Face Recognition, Face Detection

I. INTRODUCTION

Images containing faces are essential to intelligent vision-based human computer interaction, and research efforts in face processing include face recognition, face tracking, pose estimation, and expression recognition [1]. Face detection and tracking find applications in areas like video structuring, indexing, and visual surveillance and form active areas of research. If the application is to identify an actor in a video clip or to find a particular shot in the video sequence in which the actor is playing, then faces are the most important "basic units." This requires detection and tracking of a face through a sequence [2]. Research on computer-based face recognition has been an active area of study in recent years. This research has applications in person identification and verification for security systems, facial expression analysis and face classification [3].

Visual content analysis has become a hot topic in robotic vision due to its application in intelligent understanding of visual scenes, which can enable robot or computer with at least two gifts in practical applications: one is automatic localization and mapping [simultaneous localization and mapping (SLAM)] for 3-D scene structure understanding, and another is the smart recognition of salient objects presented in the scene [4].

Among various visual perception tasks, specific human head detection is a primary commission for human–computer interaction (HCI) applications, where computer or robotic systems may need to detect human in the scene, judge their behavior, and adjust their action adaptively. With this viewpoint, an intelligent vision-based system needs to track human motion and understand the events happened in the scene, which leads to a smart perception in assigned tasks, such as finding the right person's face in the visual scene [4]. Tracking human motion with computer vision techniques has been a popular research topic, due to potential applications for surveillance, security and human computer interface [5].

Visual tracking is an important and challenging problem in computer vision. Depending on applicative context under concern, it comes into various forms (automatic or manual initialization, single or multiple objects, still or moving camera, etc.), each of which being associated with an abundant literature. In a recent review on visual tracking, tracking methods are divided into three categories: point tracking, silhouette tracking, and kernel tracking. These three categories can be recast as "detect-before-track" tracking, dynamic segmentation and tracking based on distributions (color in particular) [6].

Target tracking is an important field that attracted a lot of interest in computer vision. Available techniques for object tracking use different approaches like background subtraction or modeling, particle and Kalman filtering, segmentation, supervised learning, etc. [7, 8].

Object tracking is an important task for many applications in the area of computer vision and especially in those related to video surveillance. Recently, the research community has focused its interests on developing smart applications to augment event detection capability in video surveillance systems. Generally, in order to provide coverage of large environments, many cameras are used to ensure object visibility across a large range of depths and to minimize the effects of occlusions [9].

Real-time object tracking is a critical task in computer vision applications. Many tracking algorithms have been proposed to overcome the difficulties arising from noise, occlusion, clutter and changes in the foreground object or in the background environment. Among the various tracking algorithms, mean shift-tracking algorithms have recently become popular due to their simplicity and efficiency [10].

Face recognition and identification from a video sequence is an important problem especially in surveillance and information security. Face recognition based on video is preferable over using still images, and motion helps in recognition of (familiar) faces when the images are negated,

inverted or threshold. It was also demonstrated that humans could recognize animated faces better than randomly rearranged images from the same set. Though recognition of faces from video sequence is a direct extension of still-image-based recognition, in our opinion, true video based face recognition techniques that coherently use both spatial and temporal information started only a few years ago and still need further investigation. Significant challenges for video-based recognition still exist; we list several of them here [11].

The human face is the most common 'biometric' used by people to identify others. The friends and co-workers recognize us primarily by face. Formal enrollment processes create ID cards, such as a passport or driver's license, by binding the name and other pertinent information to a photograph. Thus, even a stranger might identify us by this 'picture ID'. Given this social background, the human face is a prime candidate for biometric identification by a machine [12, 13, 15, 17 - 21].

In [14], the very low-resolution (VLR) problem in face recognition is addressed in which the resolution of the face image to be recognized is lower than 16 x 16. With the increasing demand of surveillance camera-based applications, the VLR problem happens in many face application systems. Existing face recognition algorithms are not able to give satisfactory performance on the VLR face image.

In [16], a new database is presented suitable for both 2-D and 3-D face recognition based on photometric stereo (PS): the Photo face database. The database was collected using a custom-made four-source PS device designed to enable data capture with minimal interaction necessary from the subjects.

As face recognition applications progress from constrained sensing and cooperative subjects scenarios (e.g., driver's license and passport photos) to unconstrained scenarios with uncooperative subjects (e.g., video surveillance), new challenges are encountered. These challenges are due to variations in ambient illumination, image resolution, background clutter, facial pose, expression, and occlusion[23-30].

The rest of the paper is organized as follows: feature extraction is discussed in Section 2 of this paper; Section 3 describes nearest neighbor. Section 4 describes the proposed system. Section 5 presents the results and observations of this study and finally, the conclusion is presented in Section 6.

II. FEATURE EXTRACTION

2.1 Gabor Feature Gradient

The Gabor feature representation of a grey-scale face image is performed [31,32]. The Gabor wavelet representation of a face image contains discriminative information that is considered to be robust against changes in illumination, pose and facial expression.

2.2 Principal Component Analysis

PCA is mathematically defined as an orthogonal linear transformation that transforms the data to a new coordinate system such that the greatest variance by any projection of the data comes to lie on the first coordinate (called the first principal component), the second greatest variance on the second coordinate, and so on. PCA is theoretically the optimum transform for given data in least square terms.

PCA can be used for dimensionality reduction in a data set by retaining those characteristics of the data set that contribute most to its variance, by keeping lower-order principal components and ignoring higher-order ones. Such low-order components often contain the "most important" aspects of the data. However, depending on the application this may not always be the case.

For a data matrix, XT, with zero empirical mean (the empirical mean of the distribution has been subtracted from the data set), where each row represents a different repetition of the experiment, and each column gives the results from a particular probe, the PCA transformation is given by:

$$\mathbf{Y}^{\mathbf{T}} = \mathbf{X}^{\mathbf{T}}\,\mathbf{W} = \mathbf{V}\,\mathbf{\Sigma} \qquad (1)$$

where V Σ WT is the singular value decomposition (svd) of XT.

PCA has the distinction of being the optimal linear transformation for keeping the subspace that has largest variance. This advantage, however, comes at the price of greater computational requirement if compared, for example, to the discrete cosine transform [33].

III. NEAREST NEIGHBOR RECOGNIZER

The Nearest Neighbor recognizer was adopted for recognition [34],the Mahalanobis Cosine (MAHCOS) distance is used for similarity measures. For both face identification/verification the minimum distance classifier using Mahalanobis Cosine (MAHCOS) distance gives the best results [35].

IV. THE PROPOSED FACE RECOGNITION SYSTEM

The proposed face recognition system is described as in the following stages:

Stage 1- Preprocessing: Preprocessing of faces images prior to face detection and classification is essential.

Stage 2- Face Detection: In this stage, the face is detected using the proposed skin method [22].

Stage 3- Gabor Feature Extraction: This stage is extracting Gabor magnitude features from the rectangular image obtained in stage 2[31,32].

Stage 4- PCA Feature Extraction: In this stage, PCA is used for dimensionality reduction.

Stage 5- Recognition Process: In this part, a new face is recognized using nearest neighbor recognizer. All stages of the proposed system are illustrated in figure 1.

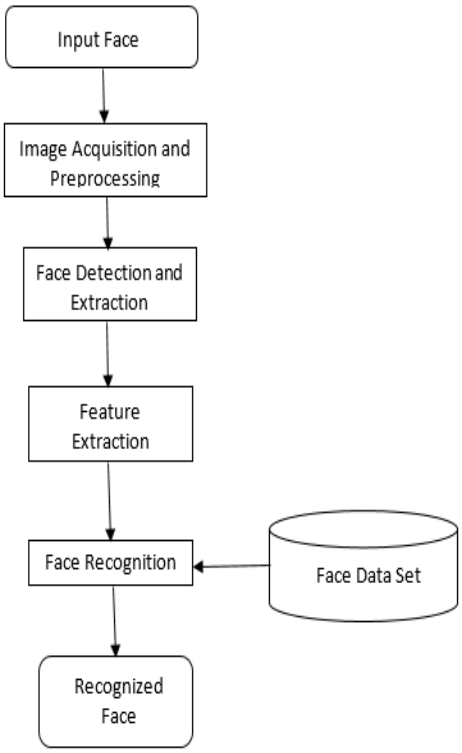

Figure 1 The proposed face recognition system.

V. EXPERIMENTS AND RESULTS

The face image database used in the experiments is the ORL Database of Faces[36], which consists of 40 subjects with10 face images available for each subject. Some samples of images from this database is shown in figure 2. These face images varies in facial expression and illumination. In the experiments, the size of each image is 92x112 pixels, with 256 grey levels per pixel. The data in experiments were divided into training, evaluation and test sets. The first 3 images will serve as the training set, the next three images will serve as the evaluation set and the remaining images will serve as test image set .MATLAB Version 7.10.0.499 (R2010a) is used to conduct the experiments.

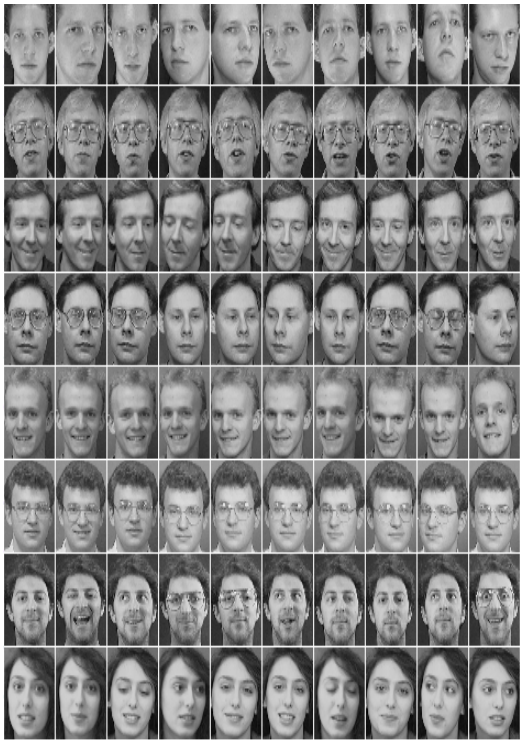

Fig. 2. Sample images of AT&T Laboratories Cambridge Faces Directories (The ORL Database of Faces).

The results of the proposed method are shown in the figures 3.

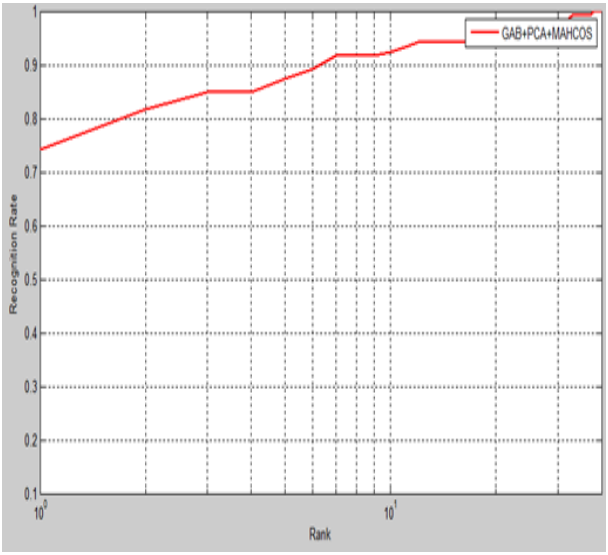

Figure 3: the recognition rate of the proposed method

Fig. 4. Sample images: The university of Tabuk instructors.

The proposed method shown in Fig. 1 is compared with PCA, DCT and Haar wavelets using the data set in figure 4. The results are shown in figure 5.

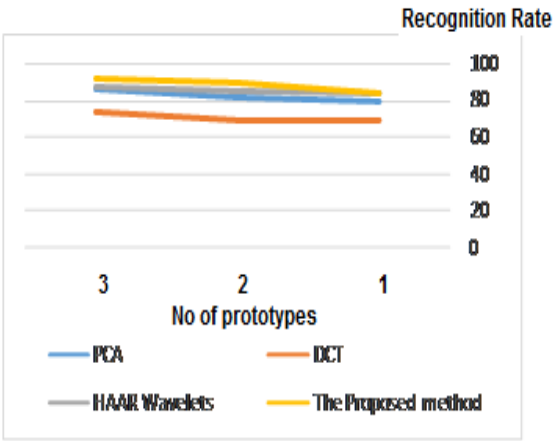

Fig. 5. The recognition rate of the proposed method, PCA, DCT and Haar Wavelets.

VI. CONCLUSION

The proposed face recognition system based on Gabor features and PCA using Nearest Neighbor has been introduced and evaluated. Using Nearest Neighbor, the proposed face recognition system gave the highest recognition rate in all the experiments, as compared with PCA, DCT and Haar wavelet.

VII. ACKNOWLEDGMENT

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VIII. REFERENCES

1- Ming-Hsuan Yang, David J. Kriegman, and Narendra Ahuja, Detecting Faces in Images: A Survey, IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 24, NO. 1, JANUARY 2002.

2- Ragini Choudhury Verma, CordeliaSchmid, and KrystianMikolajczyk, Face Detection and Tracking in a Video by Propagating Detection Probabilities. IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 25, NO. 10, OCTOBER 2003.

3- Alice J. O'Toole, Joshua Harms, Sarah L. Snow, Dawn R. Hurst, Matthew R. Pappas, Janet H. Ayyad, and Herve´ Abdi, A Video Database of Moving Faces and People, IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 27, NO. 5, MAY 2005.

4- Richard M. Jiang, Abdul H. Sadka, and Danny Crookes Multimodal Biometric Human Recognition for Perceptual Human–Computer Interaction, IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART C: APPLICATIONS AND REVIEWS, VOL. 40, NO. 6, NOVEMBER 2010.

5- CHENG-YUAN TANG, ZEN CHEN and YI-PING HUNG, AUTOMATIC DETECTION AND TRACKING OF HUMAN HEADS USING AN ACTIVE STEREO VISION SYSTEM, International Journal of Pattern Recognition and Artificial Intelligence, Vol. 14, No. 2 (2000) 137-166.

6- AurelieBugeau and Patrick Perez, Track and Cut: Simultaneous Tracking and Segmentation of Multiple Objects with Graph Cuts, EURASIP Journal on Image and Video Processing, 2008.

7- FadiDornaika Angel D. Sappa, Evaluation of an appearance-based 3D face tracker using dense 3D data, Machine Vision and Applications (2008) 19:427–441.

8- Moulay A. Akhloufi, Real-time target tracking using a Pan and Tilt platform, World Academy of Science, Engineering and Technology 60 2009.

9- Micheloni, G.L. Foresti and L. Snidaro, INTELLIGENT DISTRIBUTED SURVEILLANCE SYSTEMS: A network of co-operative cameras for visual surveillance, IEE Proc.-Vis. Image Signal Process., Vol. 152, No. 2, April 2005.

10- JIFENG NING, LEI ZHANG, DAVID ZHANG *and* CHENGKE WU, ROBUST OBJECT TRACKING USING JOINT COLOR-TEXTURE HISTOGRAM, International Journal of Pattern Recognition and Artificial Intelligence, Vol. 23, No. 7 (2009) 1245–1263.

11- GenciCapi, A Robotic System for Intelligent Real Time Face Recognition, ICGST- ARAS Journal, Volume (09), Issue (1), July, 2009.

12- D. Colbry G. Stockman, Real-time identification using a canonical face depth map, IET Comput. Vis., 2009, Vol. 3, Iss. 2, pp. 74–92.

13- Georgios Passalis, PanagiotisPerakis, TheoharisTheoharis, and Ioannis A. Kakadiaris, Using Facial Symmetry to Handle Pose Variations in Real-World 3D Face Recognition, IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 33, NO. 10, OCTOBER 2011.

14- Wilman W. W. Zou, and Pong C. Yuen, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 21, NO. 1, JANUARY 2012 327, Very Low Resolution Face Recognition Problem.

15- Dirk Smeets, Peter Claes, JeroenHermans, Dirk Vandermeulen, and Paul Suetens, A Comparative Study of 3-D Face Recognition Under Expression Variations, IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART C: APPLICATIONS AND REVIEWS, VOL. 42, NO. 5, SEPTEMBER 2012
16- StefanosZafeiriou, Gary A. Atkinson, Mark F. Hansen, William A. P. Smith, VasileiosArgyriou, Maria Petrou, Melvyn L. Smith, and Lyndon N. Smith, , Face Recognition and Verification Using Photometric Stereo: The Photoface Database and a Comprehensive Evaluation, IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 8, NO. 1, JANUARY 2013 121.
17- C.-S. Lee A. Elgammal, Non-linear factorised dynamic shape and appearance models for facial expression analysis and tracking, IET Comput. Vis., 2012, Vol. 6, Iss. 6, pp. 567–580.
18- Rui Min, Jongmoo Choi, Gérard Medioni, Jean-Luc Dugelay, Real-Time 3D Face Identification from a Depth Camera, 21st International Conference on Pattern Recognition (ICPR 2012), November 11-15, 2012. Tsukuba, Japan.
19- HassenDrira, Boulbaba Ben Amor, Anuj Srivastava, Mohamed Daoudi, and Rim Slama, IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 35, NO. 9, SEPTEMBER 2013, 3D Face Recognition under Expressions, Occlusions, and Pose Variations
20- Xiaowu Chen, Hongyu Wu, Xin Jin, and Qinping Zhao, Face Illumination Manipulation Using a Single Reference Image by Adaptive Layer De, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 22, NO. 11, NOVEMBER 2013.
21- Gustavo A. Peláez C., Fernando García, Arturo de la Escalera, and José MaríaArmingol, Driver Monitoring Based on Low-Cost 3-D Sensors, IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 15, NO. 4, AUGUST 2014.
22- http://vgl-ait.org/cvwiki/doku.php?id=matlab:tutorial:detectface#references
23- ARM7, B.koteswarrao, P. Rama Krishna , MA.Wajeed, Real Time Embedded Face Recognition using, International Journal of Research in Computer and Communication Technology, Vol 2, Issue 5, May-2013.
24- Muhammad Fahad Khan and FarhanAadil, Efficient Car Alarming System for Fatigue Detection during Driving, International Journal of Innovation, Management and Technology, Vol. 3, No. 4, August 2012.
25- Sheifali Gupta &Er. Garima, Road Accident Prevention System Using Driver's Drowsiness Detection by Combining Eye Closure and Yawning, International Journal of Research (IJR) Vol-1, Issue-6, July 2014 ISSN 2348-6848.
26- P. Jime´nez J. Nuevo L.M. Bergasa M.A. Sotelo, Face tracking and pose estimation withautomatic three-dimensional model construction, IET Comput. Vis., 2009, Vol. 3, Iss. 2, pp. 93–102.
27- Wei Zhang, Bo Cheng, Yingzi Lin, Driver Drowsiness Recognition Based on Computer Vision Technology, TSINGHUA SCIENCE AND TECHNOLOGY, Volume 17, Number 3, June 2012, pp354-362.
28- Gustavo A. Peláez C., Fernando García, Arturo de la Escalera, and José MaríaArmingol, Driver Monitoring Based on Low-Cost 3-D Sensors, IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 15, NO. 4, AUGUST 2014.
29- Lacey Best-Rowden, Student, Hu Han, Charles Otto,Brendan F. Klare, , and Anil K. Jain, Unconstrained Face Recognition: Identifying a Person of Interest From a Media Collection, IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 9, NO. 12, DECEMBER 2014.
30- TayyabaAzima, M. ArfanJaffara, Anwar M. Mirzada, Fully automated real time fatigue detection of drivers through FuzzyExpert Systems, Applied Soft Computing 18 (2014) 25–38.
31- Vitomir STRUC, Nikola PAVESIC, Gabor-Based Kernel Partial-Least-Squares Discrimination Features for Face Recognition, INFORMATICA, 2009, Vol. 20, No. 1, 115-138
32- VitomirStruc and Nikola Pavesic, The Complete Gabor-Fisher Classifier for Robust Face Recognition, EURASIP Journal on Advances in Signal Processing Volume 2010.
33- Jolliffe I.T., 2002. Principal Component Analysis, Series: Springer Series in Statistics, Springer, 2002.
34- Nearest Neighbour Classifier, http: //www.robots.ox.ac.uk /dclaus/ digits/ neighbour.htm.
35- Rehab M. Ibrahim, Prof. F.E.Z Abou-Chadi and Prof. A. S. Samra, Plastic Surgery Face Recognition: A comparative Study of Performance, IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 5, No 2, September 2013.
36- http://www.cl.cam.ac.uk/Research/DTG/attarchive:pub/data/att_faces.tar.Z

