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A Review: Video Face Recognition under Occlusion

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Abstract— Identifying faces in images is easier but face identification in videos is more difficult than that in images because of low resolution, occlusion, non-rigid deformations, large motion, complex background and other uncontrolled conditions make the results of face detection and recognition unreliable. It is a challenging problem due to the huge variation in the appearance of faces in video to achieve accuracy. The main objective of proposed system is to efficiently identify faces even in case of occlusion like glasses, etc. which results in accuracy of system. Facial occlusions, due for example to sunglasses, hats, scarf, beards etc., can significantly affect the performance of any face recognition system. Unfortunately, the presence of facial occlusions is quite common in real-world applications especially when the individuals are not cooperative with the system such as in video surveillance scenarios. While there has been an enormous amount of research on face recognition under pose/illumination changes and image degradations, problems caused by occlusions are mostly overlooked. The focus of this paper is thus on facial occlusions, and particularly on how to improve the recognition of faces occluded by sunglasses and scarf. We propose an efficient approach which demonstrates state-of-the-art performance on streaming video face recognizing in various genres of videos and label them with the corresponding relevant names.

Keywords— Face Detection, Face Recognition, Facial Occlusion, Streaming Video.

I. INTRODUCTION

Due to the enormous growth in movies, video application, a huge amount of data is being generated every day. Automatic face identification of faces in videos has drawn significant research interests and led to many securities based applications. A key issue in face identification in videos is more difficult than that in images because of low resolution, occlusion, non-rigid deformations, large motion, complex background and other uncontrolled conditions make the results of face detection and tracking unreliable. In presence of occlusion on faces in videos, the situation is even worse. It is a challenging problem due to the huge variation in the appearance of each character in streaming videos. The proposed schemes demonstrate state-of-the-art performance on streaming video face recognizing in various genres of videos and label them with the corresponding relevant names.

Face is a complex multidimensional structure .The face is our primary and first focus of attention in social life playing an important role in identity of individual. Faces could be applied to a wide variety of practical applications including criminal identification, security systems, identity verification, video surveillance, etc.

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Face recognition is an integral part of biometrics. In biometrics basic traits of human is matched to the existing data and depending on result of matching identification of a human being is traced. There are various Issues in face recognition, Pose variation, Occlusion, Facial expression, Imaging condition, Low resolution, Complex background, uncontrolled condition ,etc hence It will be unreliable to identify the n faces this degrades the system accuracy. So this study is motivated by these challenges.

II. FACE DETECTION

Face detection is the first stage of a face recognition system. A lot of research has been done in this area, most of that is efficient and effective for still images only. So could not be applied to video sequences directly. In the video scenes, human faces can have unlimited orientations and positions, so its detection is of a variety of challenges to researchers. Generally, there are three main processes for face detection based on video. At first, it begins with frame based detection. During this process, lots of traditional methods for still images can be introduced such as statistical modeling method, neural network-based method, SVM-based method, HMM method, BOOST method and color-based face detection, etc. However, ignoring the temporal information provided by the video sequence is the main drawback of this approach. Secondly, integrating detection and tracking, this says that detecting face in the first frame and then tracking it through the whole sequence. Since detection and tracking are independent and information from one source is just in use at one time, loss of information is unavoidable. Finally, instead of detecting each frame, temporal approach exploits temporal relationships between the frames to detect multiple human faces in a video sequence. In general, such method consists of two phases, namely detection and prediction and then update-tracking. This helps to stabilize detection and to make it less sensitive to thresholds compared to the other two detection categories.

A. Typical Approaches

In 2000, Zhu Liu and Yao Wang presented a fast template matching procedure by iterative dynamic programming (DP) to detect frontal faces and track non-frontal faces with online adapted face models. Meanwhile, a fact was observed that a higher edge concentration appeared in the vicinity of facial features but less edge concentration appeared when slightly outside of facial features. Base on this fact, Li Silva et. al. proposed a method, named edge pixel counting, to detect and track facial features in video sequences. In [11], Han et al. accomplished tasks of detecting and tracking multiple objects of unknown and varying number by using a graph structure that maintains multiple hypotheses. And in, automatic appearance models were built based on appropriate clustering over video segments. In addition, some approaches combined Edge Orientation Features to enhance the efficiency of detection. In order to fully use the temporal information provided by video, proposed a face detection method which made use of local histograms of wavelet coefficients represented with respect to a coordinate frame fixed to the object. What is more, Zhenqiu Zhang et al. Proposed Floatboost based face detection to make a local decision, and then utilized temporal information to confirm and validate the results.

B. Real-time and multi-view approaches

Real-time and multi-view face detection is important in the video-based face detection. Real-time face detection methods could be classified into two groups: the first group consists of Cascade AdaBoost approach proposed by Viola and Jones [13], and the second group uses color information to detect and validate human face [14]. A non-parametric statistical technique is exploited by Bradski et al. to detect faces in 3D. Schneiderman and Kanade claimed their system to be the first one in the world for multi-view face detection. Over past years, much progress had been made in the area. There exist two main methods:(A) The method concerns building a single detector to deal with all views of faces ;(B)The method focuses on building several detectors response for different views. Feraud et al. used an array of 5 detectors with each detector for one view. The detectors rotate to perceive the pose changes, based on trajectories of faces in linear PCA feature spaces, provided a useful mechanism for investigating these changes. In addition, detector-pyramid architecture was presented in, which adopted an integrated strategy of coarse-to-fine view decomposition, and simple-to-complex face or non-face classification. For achieving the minimum error rate, Li and Zhang proposed an algorithm by integrating the principle of both Cascade AdaBoost and detector array. However, as far as most of these approaches are concerned, a serious problem occurs because in-class variability of multi-view faces dataset is larger than that of front-view faces dataset. Though Detector-Pyramid Architecture AdaBoost (DPAA) is able to handle this problem, the complexity increased leads to high computational load and over-fitting in training. Over-fitting has been addressed in; however, robust approaches are still required.

III. FACE RECOGNITION

Face recognition is the most significant stage in the whole system. Parts of the video based algorithms utilize approaches on the basis of still-to-still techs. However, videos are capable of providing more information than still image. There are four major advantages for using video: First is the possibility of employing redundancy contained in the video sequence to improve still images recognition performance. Second, recent psychophysical and neural studies have shown that dynamic information is very crucial in the human face recognition process. Third, more effective representations, such as a 3D face model or super-resolution images, can be acquired from the video sequence and be used to improve recognition effects. Fourth, besides those motivations mentioned above, video-based recognition allows learning or updating the subject model over time. Though the advantages are obvious, there also exits some disadvantages. For example, poor video quality, low image resolution, and other influence factors (such as illumination, pose change, motion, occlusion, decoration, expression, large distance from camera, etc.) In spite of all those advantages and disadvantages, there are various aspects of approaches for video based face recognition.

A. Spatio-temporal information based approaches

Most of the recent approaches utilize spatio-temporal information for face recognition in video. Typically, some use temporal voting to improve identification rates. There are also several algorithms which extract 2D or 3D face structure from the video. Other than simple voting approaches, Li et al. proposed a method based on shape and texture models and kernel feature extraction as well. However, such method doesn't fully use the coherence information. Zhou and Chellappa presented a method for incorporating temporal information in a video sequence for the task of human recognition. A state space model with tracking state vector and recognizing identity variable was

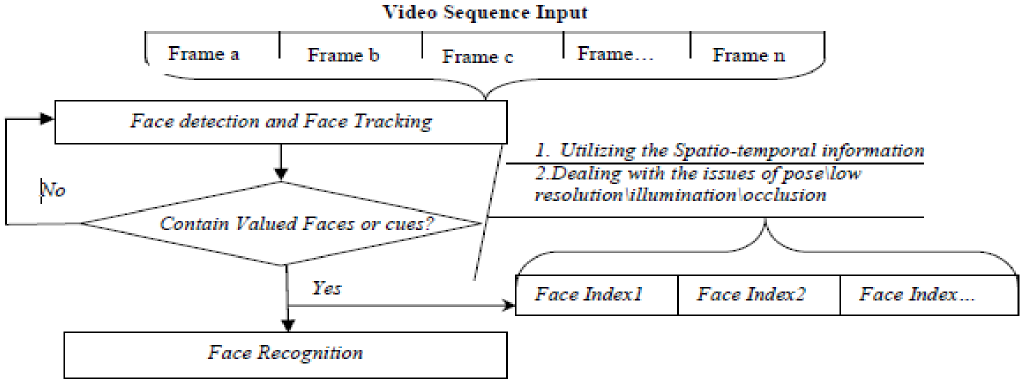

Fig. 1 Process of face recognition in video

used to characterize the identity. This probabilistic approach aimed to integrate motion and identity information over time though sequential importance sampling algorithm (SIS); it nevertheless considered only identity consistency in temporal domain and thus it may not work well when the target is partially occluded. Compared PCA, LDA and ICA in multiple images with those in video sequences, it is proved that weighed probabilistic approach can solve the problems, namely occlusion errors of localization, existed in the single still image. In Krueger and Zhou selected representative face images as exemplars from training videos by on-line version of radial basis functions. This model is effective in capturing small 2D motion but it may not deal well with large 3D pose variation or occlusion. Li et al. applied piecewise linear models to capture local motion. And a transition matrix among these models is taken to describe nonlinear global dynamics. Similar method was proposed by Kuang-Chih Lee, which took the way of propagating the probabilistic likelihood of the linear models through the transition matrix. The condensation algorithm could be used as an alternative to model the temporal structures. The methods based on spatio-temporal representations for face recognition in video have some drawbacks: (i) though the local information is very important to facial image analysis, it is not well exploited; (ii) personal specific facial dynamics are useful for discriminating between different persons, however the intra-personal temporal information which is related to facial expression and emotions is also encoded and used; and (iii) equal weights are given to the spatiotemporal features despite the fact that some of the features contribute to recognition more than others;(iv) a lot of methods can only handle well aligned faces thus limiting their use in practical scene.

B. Statistic model based approaches

Zhou et al obtained statistical models from video by using low level features (e.g., by PCA) contained in sample images, which was used to perform matching between a single frame and the video stream or between two video Streams. Satoh matched two video sequences by selecting the pair of frames those were closest across the two videos, which is still-to-still matching inherently. A few methods use video sequence to train a statistical model face for matching. The mutual subspace method in took the video frames for each person separately to compute many individual eigenspaces, considering the angle between input and reference subspaces formed by the principal components of the image sequences as the measure of similarity. In a method was proposed by using kernel principal angles on the original image space and using a feature space as the measure of similarity between two video sequences. For the sake of improvement, in the author proposed simple algorithm based on facial features and positions to select the representative frames, then dimensional analyses were applied to transform them into new spaces. In the proposed scheme achieved better performance to learn a sparse representation from video clips for online face recognition in an unconstrained environment. In a new classification algorithm, namely principle component null space analysis (PCNSA),is designed that is suitable for the problem in which different classes have unequal and nonwhite noise covariance matrices. Recently, the Auto-Regressive and Moving Average (ARMA) model was used to model a moving face as a linear dynamical system and perform recognition. The widely used Hidden Markov models (HMM) have also been applied to face recognition in video. Liu et al. used HMM and ARMA models for direct video level matching. In it showed that the problem of visual constraints could be solved by HMM-based recognition framework.

C.Hybrid cues based approaches

Video can provide more information than still image. Some methods utilize other cues obtained from video sequences, such as voice, gait, motion etc. For example, Shan et al. investigated the fusion of face and gait at feature level and gained performance increase by combining the two cues. In presented a new approach based on integrating information from side face and gait at the feature level by PCA and

MDA. Adopted a face and speaker recognition techniques for audio-video biometric recognition. The paper combined histogram normalization, boosting technique and a linear discrimination analysis to solve the problem like illumination, pose and occlusion and proposes an optimization of a speech denoising algorithm on the basis of Extended Kalman Filter(EKF). In an approach was presented by radial basis function neural networks, which is used to recognize a person in video sequences by using face and mouth modalities.

D. Advanced Topics

For the past several years, more popular areas of video-based face recognition technology are as follows:

1) *Illumination*

Many factors influence face recognition, among them the major two challenges are: illumination and pose. It is difficult for system to make recognition of individuals when change in light is larger. Adini, Moses, and Ullman first observed it. But, Zhao and Chellappa gave a theoretical proof of it on the basis of eigenface system projection. To handle such problems, the researchers propose various approaches. To handle such problems, the researchers have already proposed various approaches during these years. Belhumeur et al. and Bartlett et al. adopted the World Academy of Science, Engineering and Technology Vol:3 2009-12-25 276 International Science Index Vol:3, No:12, 2009 waset.org/Publication/15131 PCA by discarding the first few principal components and achieved better performance for images under different lighting conditions. Their assumption is that first principal components capture only variations due to lighting. Consequently, some important discarded can influence the recognition under normal lighting conditions. In addition, some approaches are presented based on thoroughly mining the features of image. In the Discrete Cosine Transform was employed by Chen et al. to compensate for illumination variations in the logarithm domain. Jacobs et al. presented a method based on the fact that, for point light sources and objects with Lambertian reflectance, the ratio of two images from the same object is simpler than the ratio of images from different objects. Nanni et al. proposed local based methods based on the Gabor filter. Liu et al. [90] used a ratio image to solve the illumination variation. Similar method had been proposed by Wang, et al., which aimed to acquire an illumination-invariant face feature image for a group of images of the same subject. In, a hybrid approach based on the use of PCA and correlation filters was proposed. In Du et al. a wavelet based normalization method was presented. Local Binary Pattern (LBP) has attracted much attention since first proposed by Ojala et al. Some other researches also made respective contributions to this method, for instance, multi-resolution LBP was presented where neighborhoods of different sizes are considered to deal with textures at different scales, and the uniform LBP, characterized by at most one 0–1 or 1–0 transition, to better represent primitive structural information such as edges and corners. Zhang et al. Proposed to couple the LBP representation with Gabor phases. Local ternary pattern (LTP) was proposed by Tan and Triggs, which was also an extension of LBP. Recently, in an effective method of handling illumination variations was presented by using illumination cone. This method also dealt with shadowing and multiple lighting conditions which were on the basis of 3D linear subspace. The main side effect of this method is that the training set requires more than 3 aligned images per person.

2) *Pose issues*

Pose is another most important factor for face recognition system. Current approaches can be divided into three groups: multiple images approaches, hybrid approaches and single image based approaches. In multiple images approaches, illumination cone and 3D surface based methods have been proposed to solve both illumination and pose problems. The hybrid approaches might be the most practical solution up to now, including linear class based method which is on the basis of assumption of linear 3D object classes and extension of linearity to images, graph matching based method with EBGM and view-based eigenface method by constructing eigenfaces for each pose. The last group was proposed, but it is hard to apply currently due to high computational cost and complexity. New AAM methods have been proposed to handle both varying pose and expression. In, Eigen light-fields and Fisher light-fields method was proposed to do pose invariant face recognition. A method by 3D model of the entire head for exploiting features like hairline, which handled large pose variations in head tracking and video-based face recognition was presented. Computing the Kullback-Leibler divergence between testing image sets and a learned manifold density was the other thought. In learns manifolds of face variations for face recognition in video. In, the research said they achieved pose robustness by decomposing each appearance manifold into semantic Gaussian pose clusters, comparing the corresponding clusters and fusing the results by RBF network.

3) 3D researches

Face recognition based on 3D is a hot research topic.

Generally, reprehensive methods can be divided into three main categories, namely, 2D images based, 3D images based and multimodal systems. The differences among these three categories are as follows: the first category includes approaches which use 2D images and 3D generic face model to improve the robustness and recognition rate. And for the second one, the methods work directly on 3D datasets. While the last group means those which utilize both 2D and 3D information. An example is given by Blanz and Vetter in that proposed a method to create 3D face models from a single image. Zhang and Cohen morphed 3D generic model from multi-view images by way of using a cubic polynomial. But, it is still doubtable that whether 3D facial reconstruction from a single view image or multi-view images can be considered good enough. Since 2000, more and more multimodal approaches have been proposed to improve face recognition performance. Dalong Jiang et al. proposed an efficient and fully automatic 2D-to-3D integrated face reconstruction method in an analysis-by-synthesis manner. 3D face shape was reconstructed according to the feature points and a 3D face database. Then the face model was texture-mapped by projecting the input 2D image onto the 3D face shape. The author synthesizes virtual samples with variant PIE to represent the 2D face image space. In, the system was based on real-time quasi-synchronous color and 3D image acquisition was based on the color structured-light approach. 3D information made the segmentation and detection straightforward with mixture of Gaussians assumption. The parameters were estimated by Expectation Maximization algorithm. Besides, it also made the pose and illumination compensate for each other, which led to the improvement of face recognition.

4) Low Resolution

It is difficult to recognize human faces in video of low resolution. With the widely use of camera (surveillance etc.), solutions which solve such problems achieve more World Academy of Science, Engineering and Technology Vol:3 2009-12-25 277 International Science Index Vol:3, No:12, 2009 waset.org/Publication/15131 and more attention. The main two methods are Super Resolution (SR) and Multiple Resolution-faces (MRF) approach. The former can be applied to estimate high-resolution facial image from low-resolution ones. However, the disadvantage is that the multiple facial images that belong to the same subject captured from same scene are required. MRF overcame such drawback; it increases the complexity and requires more memory storage in face recognition system. Recently, researchers improved existing methods of SR & MRF and proposed some new methods. In, color invariance was applied to face recognition. Their results showed that color invariants do have substantial discriminative power and increase the robustness and accuracy for low resolution facials. In, the author proposed an approach to provide a feature subspace to be directly compatible with randomly changeable low-resolution of probe at application/testing stage and overcome dimension mismatch problem. In the authors constructed high-resolution frames from a video sequence by using both spatial and temporal information present in a number of adjacent low-resolution ones. A new technique named face scoring was given by Tse-Wei Chen et al. The method included eight scoring functions based on feature extraction technique, integrated by a single layer neural network training system to obtain an optimal linear combination to select high-resolution faces.

IV. Occlusion

Facial occlusions may occur for several intentional or undeliberate reasons (See Fig. 1). For example, Football hooligans and ATM criminals tend to wear scarf and/or sunglasses to prevent their faces from being recognized. Some other people do wear veils for religious convictions or cultural habits. Other sources of occlusions include medical masks, hats, beards, moustaches, hairs covering the face, make up, etc. Undoubtedly, occlusions can significantly affect the performance of even most sophisticated face recognition systems, if occlusion analysis is not specifically taken into account. The focus of this paper is on how to improve face recognition performance under occlusions, particularly caused by sunglasses and scarf.

Fig No. 1 Examples of occluded face images from different sources

V. Literature Riview

A. *Glasses Removal from Facial Image Using Recursive Error Compensation*

In this paper [1], we propose a new method of removing glasses from a human frontal facial image. We first detect the regions occluded by the glasses and generate a natural looking facial image without glasses by recursive error compensation using PCA reconstruction. The resulting image has no trace of the glasses frame or of the reflection and shade caused by the glasses. The experimental results show that the proposed method provides an effective solution to the problem of glasses occlusion and we believe that this method can also be used to enhance the performance of face recognition systems.

B. *Face Recognition under Occlusions and Variant Expressions with Partial Similarity*

Recognition in uncontrolled situations is one of the most important bottlenecks for practical face recognition systems. In particular, few researchers have addressed the challenge to recognize non-cooperative or even uncooperative subjects who try to cheat the recognition system by deliberately changing their facial appearance through such tricks as variant expressions or disguise (e.g. by partial occlusions). This paper [2] addresses these problems within the framework of similarity matching. A novel perception inspired non-metric partial similarity measure is introduced, which is potentially useful in deal with the concerned problems because it can help capturing the prominent partial similarities that are dominant in human perception. Two methods, based on the general *golden section* rule and the *maximum margin* criterion, respectively, are proposed to automatically set the similarity threshold. The effectiveness of the proposed method in handling large expressions, partial occlusions and other distortions is demonstrated on several well-known face databases.

C. *Improving the Recognition of Faces Occluded by Facial Accessories*

Facial occlusions, due for example to sunglasses, hats, scarf, beards etc., can significantly affect the performance of any face recognition system. Unfortunately, the presence of facial occlusions is quite common in real-world applications especially when the individuals are not cooperative with the system such as in video surveillance scenarios. While there has been an enormous amount of research on face recognition under pose/illumination changes and image degradations, problems caused by occlusions are mostly overlooked. The focus of this paper [3], is thus on facial occlusions, and particularly on how to improve the recognition of faces occluded by sunglasses and scarf. We propose an efficient approach which consists of first detecting the presence of scarf/sunglasses and then processing the non-occluded facial regions only. The occlusion detection problem is approached using Gabor wavelets, PCA and support vector machines (SVM), while the recognition of the non-occluded facial part is performed using block-based local binary patterns. Experiments on AR face database showed that the proposed method yields significant performance improvements compared to existing works for recognizing partially occluded and also non-occluded faces. Furthermore, the performance of the proposed approach is also assessed under illumination and extreme facial expression changes, demonstrating interesting results.

D. *Efficient Detection of Occlusion prior to Robust Face Recognition*

While there has been an enormous amount of research on face recognition under pose/illumination/expression changes and image degradations, problems caused by occlusions attracted relatively less attention. Facial occlusions, due, for example, to sunglasses, hat/cap, scarf, and beard, can significantly deteriorate performances of face recognition systems in uncontrolled environments such as video surveillance. The goal of this paper[4], is to explore face recognition in the presence of partial occlusions, with emphasis on real-world scenarios (e.g., sunglasses and scarf). In this paper, we propose an efficient approach which consists of first analyzing the presence of potential occlusion on a face and then conducting face recognition on the non-occluded facial regions based on selective local Gabor binary patterns. Experiments demonstrate that the proposed method outperforms the state-of-the-art works including KLD-LGBPHS, S-LNMF, OA-LBP, and RSC. Furthermore, performances of the proposed approach are evaluated under illumination and extreme facial expression changes provide also significant results.

VI. Praposed Work

The proposed system efficiently identifies faces even in case of occlusion like glasses, etc. which results in accuracy of system. Flow of propose work will be as follows:

Phase 1: Streaming video is nothing but the array of interrelated frames It will be difficult or non-feasible to process the video in real time hence in this phase system will process the frames and send it for further processing.

Phase 2: Once the system get the individual processing frame system will find out the face area and store it in File.

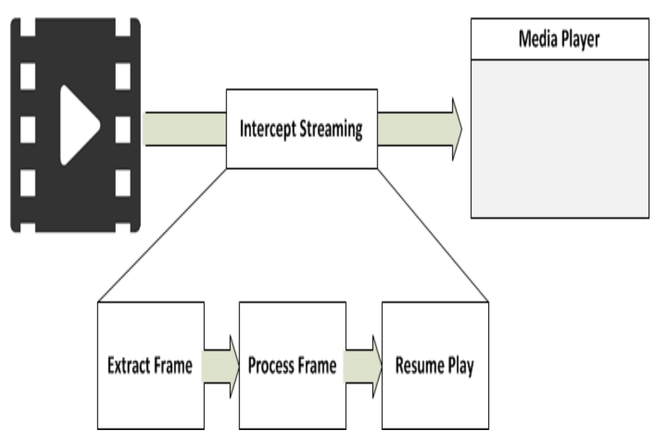

Fig No. 2 Streaming Process

Phase 3: Further each frame is analyzed from where the faces are extracted names are assigned to it. Meanwhile each processing of frame faces extraction and name association follows.

Phase 4: Streaming video is still running multiple faces occurs so the system will recognize the faces display its identification. if face are not identified then it is added to the dataset for future identification .The process carries until the media file stops playing meanwhile if occluded face occurs so the face still recognize by reconstructing the original face.

REFERENCES

[1] Jeong-Seon Park, You Hwa Oh, Sang Chul Ahn , and Seong-Whan Lee, Sr. Memb "Glasses Removal from Facial Image Using Recursive Error Compensation". IEEE Transaction on Pattern Analysis And Machine Intelligence.Vol. No.27 2012

[2] Maria De Marsico, Member, IEEE, Michele Nappi, and Daniel Riccio "Face Recognition Against Occlusions and Expression Variations . IEEE Transaction on System , Man, And Cybernetics And Humans, VOL. 40, NO. 1, January 2010

[3] Zafar G. Sheikh, V. M. Thakare, S. S. Sherekar "Advances in Face Detection Techniques in Video"2012 2nd IEEE International Conference on Parallel, Distributed and Grid Computing.

[4] Minglan Sheng, Zhangli Lan "Face Detection in Video Sequence with Complex Background" Proceedings of 2008 IEEE International Conference on electronics and Automation.

[5] Rabia Jafri and Hamid R. Arabnia* "A Survey of Face Recognition Techniques" International Journal of Information Processing Systems, June 2009

[6] Face Detection System on Ada boost Algorithm Using Haar Classifiers M. Gopi Krishna,A. Srinivasulu, Prof (Dr.) T.K.Basak International Journal of Modern Engineering Research (IJMER) Nov-Dec. 2012

[7] "Improving the Recognition of Faces Occluded by Facial Accessories " Rui Min Multimedia Communications Dept. Abdenour Hadid Machine Vision Group from University of Oulu, Finland.

[8] B.G. Park, K.M. Lee, and S.U. Lee, "Face recognition using face-ARG matching," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 27, no. 12, pp. 2005**.**

[9]Ali Javed ,Face Recognition Based on Principal Component Analysis J. Image, Graphics and Signal Processing, Feb 2013 .

[10] Ole Helvig Jensen Kongens Lyngby "Implementing the Viola-Jones Face Detection Algorithm". Kongens Lyngby 2008 in Proc. ICME, 2011, pp. 1–6.

[11] Zafar G. Sheikh, V. M. Thakare, S. S. Sherekar 2nd IEEE International Conference on Parallel, Distributed and Grid Computing "Advances in Face Detection Techniques inVideo".

[12] W. Zhang, S. Shan, X. Chen, and W Gao, "Local Gabor Binary Patterns Based on Kullback–Leibler Divergence for Partially Occluded Face Recognition," Signal Processing Letters, IEEE , vol.14, no.11, pp.875- 878, Nov. 2007.

[13]P. Viola and M. Jones, "Rapid Object Detection Using a Boosted Cascade of Simple Features," Proc. Conf. Computer Vision and Pattern Recognition, pp. 511-518, 2001.

[14]J. Yang and A.Waibel. A real-time face tracker. In Proceedings of the Third IEEE Workshop on Applications of Computer Vision, pages 142-147, Sarasota, FL, 1996.

[15]Mikolajczyk, K.; Choudhury, R.; Schmid, C. ,Face detection in a video sequence-a temporal approach, Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, Vol 2, pp: 96-101, 2001.

[16] Zhenqiu Zhang; Potamianos, G.; Ming Liu; Huang, T., Robust Multi-View Multi-Camera Face Detection inside Smart Rooms Using Spatio-Temporal Dynamic Programming, 7th International Conference on Automatic.

[17] G. Bradski. Computer vision face tracking for use in a perceptual user interface. Technical Report Q2, Intel Corporation, Microcomputer Research Lab, Santa Clara, CA, 1998.

[18] H. Schneiderman and T. Kanade. "A statistical method for 3d object detection applied to faces and cars". In Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 2000.

[19] J. Feraud, O. Bernier, and M. collobert. "A fast and accurate face detector for indexation of face images". In Proc. Fourth IEEE Computer Society Conference on Computer Vision and Pattern Recognition, pages 52-59, 1998.

[20] S. Gong, S.McKenna, and J.Collins. "An investigation into face pose distribution". In Proc. IEEE International Conference on Face and Gesture Recognition, Vermont,1996.

[21] ZhenQiu Zhang; Long Zhu; Li, S.Z.; HongJiang Zhang,Real-time multi-view face detection, Fifth IEEE International Conference on Automatic Face and Gesture Recognition, pp:142-147,2002.

[22] P. Viola and M.J. Jones, "Robust real-time object detection", IEEE ICCV Workshop on Statistical and Computational Theories of Vision. Vancouver, Canada. July 13, 2001.

[23] S. Z. Li, Z. Q. Zhang, "FloatBoost Learning and Statistical Face Detection", IEEE Transactions on Pattern
Analysis and Machine Intelligence, VOL. 26, NO. 9, September, 2004.

[24] Yan Wang; Yanghua Liu; Linmi Tao; Guangyou Xu ,Real-time multi-view face detection and pose estimation in video stream, 18th International Conference on Pattern Recognition ,pp: 354 - 357,2006.

[25] M. Nakamura, H. Nomiya and K. Uehara, "Improvement of boosting algorithm by modifying the weighting rule", Annals of Mathematics and Artificial Intelligence, 41:95-109,2004.

[26] C.J. Edward, C.J. Taylor, and T.F. Cootes, "Learning to Identify and Track Faces in an Image Sequence," Proc. Int'l Conf. Automatic Face and Gesture Recognition, pp. 260-265, 1998.

[27]J. Yang and A.Waibel. A real-time face tracker. In Proceedings of the Third IEEE Workshop on Applications of Computer Vision, pages 142-147, Sarasota, FL, 1996.

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