A REVIEW ON FACE DETECTION UNDER OCCLUSION BY FACIAL ACCESSORIES

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Abstract - *Occlusion detection in face verification is an essential problem nowadays. The facial landmark hidden by some object is termed as facial occlusion. Facial occlusions due to sunglasses, scarf etc can affect the performance of any face recognition system. This paper presents a survey on face detection under the case of occlusion. Occlusion at faces may be leads to performance degradation of face detection algorithms. There have been many methods developed for detecting occlusion in present and previous works. The aim of developing such an intelligent system is to detect the face under various performance reducing parameters. This paper reviews the performances of the best techniques used in facial occlusion detection.*

Key Words: **Occlusion, Fiducial points, Face detection, PCA, DTOD, BPNN.**

I. INTRODUCTION

Face is one of the most important human's biometrics used in every day human communication and due to some of its unique characteristics plays a major role in conveying identity. Face detection is the process of detecting one or more people in images or videos by analyzing it, which is an important part of many biometric, security, and surveillance systems. Although significant progress has been made in face detection technology, it is still suffering when facing uncontrolled environments such as occlusions, drastic illumination changes, facial pose variations etc. The goal of face detection system is to detect a face robustly as possible to the image variations such as illumination, pose, occlusion, expression, etc. While there have been numerous amounts of research works on face recognition under pose/illumination changes, problems caused by occlusions are mostly overlooked, even though facial occlusions are quite common in the real world scenarios.

Occlusion can be natural as well as synthetic. Natural occlusion refers to obstruction of views between the two objects in an image without any intension while synthetic occlusion refers to artificial blockade of intentionally covering the image's view. A face is occluded if some area of the face is hidden by wearing objects like a sunglass, a mask, hats or scarf in the eyes and mouth positions. Facial occlusions can thus degrade the performance of face detection systems. Therefore, robustness to partial occlusions is thus crucial in nowadays.

II. METHODS FOR FACIAL OCCLUSION DETECTION

In [1], Zhaohua Chen, Tingrong Xu, and Zhiyuan Han have solved the problem of face recognition under occlusion due to sun glasses or scarves. The presence of sunglasses or scarves was detected and the non- occluded region only was processed here. Occlusion can be obtained by selecting non occluded patches from the faces and was detected by using Principal Component Analysis (PCA) and Support Vector Machines (SVM). To detect the occluded region in the face, the image is divided in to finite number of patches and each patch is examined separately. They have divided faces in to 6 symmetrical patches since the configuration and size of the patches are important in the performance of occlusion detection. Then dimension of these patches were reduced by using PCA.

Xinting Pan, Xiaobo Chen and Aidong Men in work [2], proposed a particle filter for tracking the object accurately. By using background subtraction the object pixels were first classified as foreground and background in all frames. The object in the scene is considered as the region of interest (ROI). Each object was represented by an elliptical model with parameters like center of the ellipse, length of the major axis of ellipse eccentricity of the ellipse. Occlusion can be detected by the merging and splitting of the ellipse.

Rui Min, Abdenour Hadid and Jean-Luc Dugelay proposed a robust face recognition approach under occlusions which consists of first detecting the presence of scarf/sunglasses and then processing the non-occluded facial regions only in [3]. The occlusion detection is done by 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. For occlusion detection, they divide the probe image into number of facial components and each of the components is individually analyzed by an occlusion detection module. From this potential occluded face components are identified. The LBP features from non- occluded parts are selected and used for recognition. The recognition is performed by comparing the selected LBP features from the probe image with that of selected LBP features from non-occluded component in template image. This approach may not be optimal for other types of occlusions because here they are dividing face region into upper and lower part. Thus more accurate segmentation of the occluded regions may then be needed.

In [4], P. Karthigayani and S. Sridhar proposed a work in which the initial stage is to extract features using canny edge detection technique and classify the occluded and non occluded region using Decision Tree Based Occlusion Detection (DTOD) classifier. During second stage, the face verification is carried out using Elastic Matching Pattern (EMP) and the recognition is achieved by using Maximum Likelihood Classifier (MLC). Back Propagation Neural Network (BPNN) method is used to estimate the age of the human in the third stage. The proposed work deals with various conditions like illumination, variability in facial expressions, presence of occlusions. The decision tree C5.0 algorithm is used for occlusion detection in facial image. The gain ratio is calculated for the entire feature by the training vector. Entropy of the image is calculated from the information gain in the decision tree.

Pengfei Ji, Yonghwa Kim, Yong Yang in their work [5], proposed a novel scheme that combines skin color ratio texture feature for face detection for intelligent video surveillance systems. This method mainly ensure the accuracy, thus they have studied a multi-frame detection algorithm. They introduced and analyzed the codebook foreground segmentation model for extraction of moving foreground which is real-time segmentation algorithm and head detection based on HOG head detector with GPU implementation. Skin color feature and LBP feature are extracted for the fusion of decisions by weighted voting and the final recognition result is obtained in order to improve detection performance. The overall system performance through robust feature extraction is not achieved in this method.

A new approach for estimation of the positions of facial key points with three-level carefully designed convolutional networks was proposed by Yi Sun, Xiaogang Wang and Xiaoou Tang in [6]. In this proposed method, the outputs of multiple networks are fused for robust and accurate estimation at each level. First of all, the texture context information over the entire face is utilized and extracts global high-level features at higher layers of the deep structures, which can locate each keypoints. Second, the geometric constraints among key points are implicitly encoded, since the networks are trained to predict all the key points simultaneously. Thus the method can avoid local minimum caused by data corruption in image samples due to occlusions, large pose variations, and illumination variations.

In dual sparse constrained cascade regression for robust face alignment [7], proposed by Qingshan Liu, Jiankang Deng and Dacheng Tao develop a pose-insensitive dual sparse constrained cascade regression model for robust face alignment. Here face pose is estimated by five fiducial points which are located by deep convolutional neuron network. Then it is used to rotate the face image and select the corresponding regression model, which improves the model's adaptation to large pose variation. During the regressor training process, sparse constraints is incorporated for selecting all robust features and compresses the size of model. Sparse shape constraint is incorporated between each cascade regression. The process of cascade regression is embedded in the subspace constructed from the shape of the exemplar, which increases the robustness of the cascade regression model. To improve the computational efficiency, they employ K-SVD to learn a compact shape dictionary without sacrificing location accuracy.

In [8], Qingshan Liu, Jiankang Deng and Dacheng Tao present a new adaptive cascade regression model for robust face alignment. Although cascade regression achieves good performance in face alignment, it is very sensitive to occlusion since it depends on the local features around each landmark. For successfully overcoming this issue, they propose an adaptive cascade regression model which utilizes the occlusion levels of each landmark to adjust the shape-indexed features. Here the shape-indexed appearance is utilized for estimating the occlusion level for each landmark and based on this estimated occlusion levels, an adaptive weighting scheme is introduced to suppress the influence of noise corruption efficiently. Also they propose an efficient exemplar-based shape constraint for suppressing the influence of local image corruption. From the experiments conducted for face detection to face alignment, it shows the power of this model for facial landmark localization and occlusion detection.

III. CONCLUSION

The aim of this work is to provide a detailed description on various facial occlusion detection methods. The occlusion detection system involves segmentation and occlusion detection procedures as main part. Background subtraction techniques provide very good results on motion segmentation. Also patch creation on face can detect occlusion in a good way. Facial occlusion detection system shows better results while employing bounding box creation around the objects in addition to patch based frame work. Research in future are inclined towards the improvement of accuracy.

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