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A Survey on Automatic Face Recognition under Partial Occlusion

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Abstract

As one of the most successful applications of image analysis and understanding, face recognition has recently received significant attention, especially during past several years. One of the well-known problems of the face recognition is occlusion. Occlusion in image refers to hindrance in the view of an object. The article aims to give a detailed survey of the face recognition under occlusion. This survey illustrates different face recognition practices that laid fundamentals on the issue of partial occlusion dilemma where faces area disguised to cheat the security. Occlusion refers to façade of the face image which can be due to sunglasses, hair or wrapping of facial image by scarf or other accessories. Lastly a comparison of various techniques is shown in tabular format to give a precise overview of what different authors have already projected in this particular field.

Keywords-Face Recognition, Occlusion, TPGM,KED.

Introduction

A **Face Recognition System** is a computer Application capable of identifying or verifying a person from a digital image or a video frame from a video source [16]. Potential applications such as human computer interfaces, access control, security and surveillance, e-commerce, entertainment etc. [1].During the last decade, research efforts have switched from controlled and constrained scenarios to unconstrained and uncontrolled ones. However, the performance in unconstrained conditions is still unsatisfactory [2].After many years of investigation, face recognition in real-world environments is still very challenging due to the dramatic intra class variations, such as expression, viewing angle, lighting conditions, and occlusions [3][6].In real time application face image becomes occluded by facial accessories (e.g., sunglasses, scarf, cap), objects before the face (e.g., hand, food, cellular telephone), extreme illumination (e.g., shadow), self-occlusion(e.g., non-frontal pose) or poor picture quality (e.g., blurring)[4][5].

There are two related but different problems to face recognition with occlusions: occluded face detection and occluded face recovery [6]. The first task is to determine whether a face image is occluded or not [6]. The second task is to restore the occluded regions in face images [6]. An intuitive idea for handling occlusions in face recognition is to detect the occluded regions first and then perform recognition using only the non-occluded parts [6]. However, the types of occlusions are unpredictable in practical scenarios. The location, size and shape of occlusions are unknown, hence increasing the difficulty in segmenting the occluded regions from the face images [6].

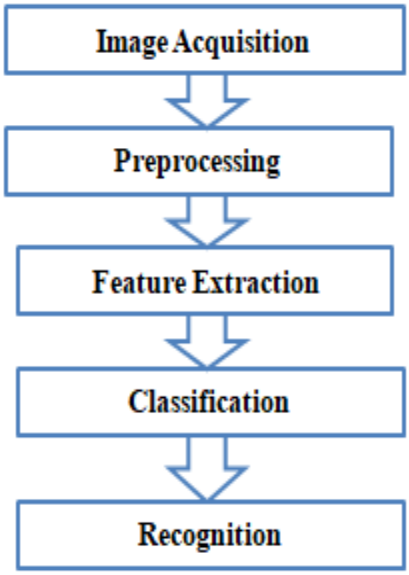

Figure 1: Facial Recognition Framework

The aim of Automated Robust face recognition system is to verifying and identifying a face from a collected image dataset. It includes the accompanying three tasks.

Verification or Face Authentication. Verification (one to one matching). The recognition system determines a face image of an unknown person along with a claim identity, ascertaining whether the person is who he/she claims to be.

Face Recognition or Identification. (One to many matching). To identifying of the person's identity by comparing with image dataset with known label identity.

Automatic Facial recognition system has some important pros over many other biometric systems – it is a non-intrusive, non-invasive, and easy to use. Because of this, it becomes one of the verification & identification technique utilized in digital passports, driver license & other biometric of choice for many other security based system.

Literature Survey

Paper 1- Learning Kernel Extended Dictionary For Face Recognition ke-kun Huang et al.[3] Author proposed kernel extended dictionary (KED) for face recognition, which provides an efficient way for combining KDA & SRC. First learn several kernel principal components of occlusion variations as an occlusion model, which can represent the possible occlusion variation efficiently. Then, the occlusion model is projected by KDA to get KED, which can be computed via the same kernel trick as new testing samples. Finally, Use structured SRC for classification, which is fast as only a small number of atoms are appended to the basic dictionary, and the feature dimension is low. Experiments are done on CAS-PEAL, AR, FERET, LFW datasets & achieve good result.

Paper 2- Topology preserving graph matching for partial face recognition Yueqi Duan et al.[7] Author Proposed a topology preserving graph matching (TPGM) method for partial face recognition. TPGM method estimates a non-rigid transformation encoding the second order geometric structure of the graph. So that more accurate and robust correspondence can be computed with the topological information. Experimental results on the LFW, AR, and Pubfig show the effectiveness of the proposed approach.

Paper 3- Face recognition with occlusion via support vector discrimination dictionary and occlusion dictionary based sparse representation classification Li Yuan et al.[8] Author proposed the face recognition with occlusion via support vector discrimination dictionary and Gabor occlusion dictionary based sparse representation classification (SVGSRC).Apply support vector machine(SVM) scheme to train the non-occlusion dictionary, guaranteeing that the resulting dictionary can not only express testing samples from the same class, but also can reduce the interference of samples of different classes. Experimental results on the AR face database which has natural occlusion gets better performance on recognition.

Paper 4- Robust Point Set Matching for Partial Face recognition Renliang Weng et al. [9] Author proposed a new partial face recognition approach to recognize persons of interest from their partial faces. Given a pair of gallery image and probe face patch. First detect key points and extract their local textural features. Then propose a robust point set matching method to discriminatively match these two extracted local feature sets, where both the textural information and geometrical information of local features are explicitly used for matching simultaneously. Experimental results on LFW, AR, PubFig database show the effectiveness of the proposed approach.

Comparative Analysis

Methodology	**Database**	**Accuracy**	**Pros**	**Cons**
Kernel Extended Dictionary [3]	CAS-PEAL, AR,FERET, LFW	High	Suppress the Intra class variations.	Not Good for Disguised face, Random/Dynamic Occlusion.
SIFT SURF SILBP Topology Preserving Graph Matching [7]	LFW,AR, PubFig	Low	Robustness.	Not Good for Disguised & makeup faces.
Support Vector Discrimination Dictionary & Gabor occlusion dictionary based SRC[8]	AR	Low	Reduce the dimension of the dictionary & improve the discriminative ability of the sparse representation.	Not Good for Unconstraint environment.
SIFTSURFSILBP Robust Point Set Matching[9]	LFW,AR, PubFig	Low	Robustness.	Not Good for Disguised face, Random/Dynamic Occlusion

Conclusion

This Survey deals with various methods that have tried to overcome the problem of partial occlusion. Many authors have worked on the face recognition systems under controlled environments but with uncontrolled conditions less work has been focused. Since all the work done so far deal with 2D face recognition approaches, results can be improved further if 3D face recognitions techniques are employed to deal with partial occlusion. Summarizing the overall methods, every technique has its pros & cons and each is effective in its own field of usage. Basically main emphasis of conducting this survey is group together all the work related to partial occlusion in face images into one document.

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