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# Partial Face Recognition Using Robust Point Set Matching

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## Abstract:

A number of methods have been proposed for recognition of a face over the past few decades. Some of them have shown promising results but they work only in well controlled condition. In this method, the face patch and the gallery image are brought to the same size before finding the similarities between the images. In our real world scenarios, a lot of faces get covered by other objects like scarfs, sunglasses, another person face in front of us, the angle between the camera and the person etc., not being able to recognise the persons face. To overcome such cases a method should be developed to identify the persons face. A gallery image and a face patch is taken, first we detect their keypoints and extract their textual features and geometric features. Then we proceed with the robust point set matching where we match keypoints with the textual features and the geometrical features of both the gallery image and the face patch image. Finally, the distance between the features is matched and the face is recognised.

*Keywords*— **Face recognition, partial face recognition, feature set matching, feature alignment, image matching**

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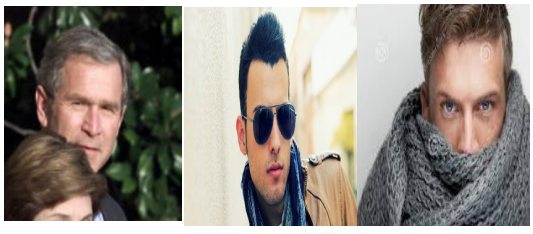
## I. INTRODUCTION

Various methods have been introduced to recognise a partial face over the past few decades. Some of them have shown promising results only under well controlled conditions. Mostly they use holistic face to recognise a face, where the gallery image and the patch image are about the same size before recognition. In our

real world scenarios, like in surveillance cameras, in some cases the image is not clear, sometimes the face gets covered by various obstacles like sunglasses, scarfs, angle between the camera and the person is not straight, there is a big crowd due to which the particular person cannot be recognised etc., in such cases it is difficult to determine the person. Because of such problems we need to develop a method which can recognise the partial face. Some of the examples of partial face is presented in fig 1.

To recognise a partial image it is very necessary to compute the similarities between the gallery image and the face patch image accurately. First the partial image is taken where the face is occluded by other and the face of the image is detected. The occluded part should be ignored and the other parts should be checked with the gallery image to find the similarities. To check the similarities, facial landmarks in the gallery image and the face patch image are detected. Checking the similarities with the detected landmarks doesn't always show promising results. That is why in this paper, we have proposed to extract features of the gallery image and face patch which contains the geometrical information and the textual information. Then the similarities of the geometrical information and the textual information is used for the matching of the image with the gallery image.



(a) (b) (c)

Fig 1: Partial faces. (a) Face covered by other person. (b) Face covered by sunglasses. (c) Face covered by scarf.

## II. RELATED WORK

We will discuss about two different topics which is related to partial face recognition.

### *2.1 Robust Face Recognition*

Many face recognition methods have been proposed to deal with the occlusions. They have achieved promising results but they work under only well controlled conditions. They are not effective if the face patch taken by us is arbitrary. This happens because in this approach the size of the face patch is same as that of the gallery image. In robust point set matching, the image is divided into many blocks and the similarity between the blocks is computed for face matching. However, in real world scenarios, occluded face parts are highly unstructured and detection of faces is unreliable. In the first attempt to recognise a partial face, the partial image was represented by MKD-GTP features which was then reconstructed by gallery image. The geometrical information was ignored in this method.

### *2.2 Feature Set Matching*

Feature set matching is a basic problem in recognising a pattern. Chui and Rangarajan presented an approach to recognise a face by aligning two different points according to their geometric distribution. The above method only uses the geometric information for recognition. Different from the above method Li *et al* proposed a method for feature matching where geometric as well as textual information is employed for face recognition. Wiskott *et al* used graph matching method for face recognition.

They first manually determine the keypoints and then compare the similarities between the images based on local features around the keypoints.

## III. PROPOSED MODEL

Since there is a presence of occlusions caused by various reasons, large degree of rotation between the face patch and gallery image. Hence, we use SIFT method for partial face matching.

### *3.1 Feature Extraction and Keypoint Selection*

For the gallery image and the face patch image, we first detect the keypoints using SIFT feature detector. The keypoints which we detected consists of the geometric information which tells us its position in the image plane and textual information for its textual description. Following are the major steps for computation of image features.

A. ***Scale-Space Extreme Detection:*** The first stage of computation deals with the searching of all the scales and image locations. By using the difference in Gaussian function the potential points are selected.

B. ***Accurate Keypoint Selection:*** After detecting the keypoints of the probe image and the gallery image, accurate keypoints should be selected for matching the images. Accurate keypoints are selected because there a lot of keypoints which are found on the face and comparing all the keypoints with the other image is highly impossible, that is why keypoints are eliminated. The most effective keypoints are selected based on their stability. Once the keypoint is selected by comparing it with the neighbouring pixels, our next step is to reject points which are having low contrast.

C. ***Orientation Assignment:*** Based on the local image gradient directions there may be more than one orientations for a particular keypoint. To determine the keypoint orientation, all the keypoint directions are computed in a histogram, so the orientation which has the maximum weightage in the histogram is considered as the orientation of the keypoint.

The feature extraction and the keypoint selection is done as shown in fig 2

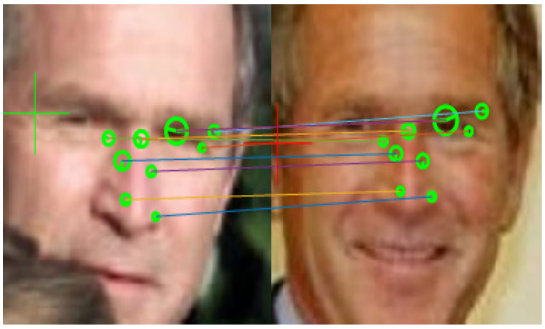


*Fig 2; feature extraction and keypoint selection*

### *3.2 Robust Point Set Matching*

By matching the corresponding geometrical features and the textual features, we align the face patch to the gallery image. The matching is done by three characteristics

- ***Subset Matching:*** since the face patch and the gallery image are not identical, some keypoints may not be able to find the corresponding keypoint

in the gallery image. That is why not all the keypoints which are detected are matched with the gallery image. Hence, this type of matching is called subset point set matching.

- ***One-one-point Correspondence:*** the keypoint of one position in the face patch should not match another keypoint position in the gallery image.
- ***Non-affine Transformation:*** the appearance of the face is not the same when there is a change in the facial expressions. Such changes are non-affine, when the image is converted into 2D.

### *3.3 Point Set Distance Matching*

It is the distance between all pair of keypoints that are present in the input and gallery images. The input image will have a set of keypoints as well as the gallery images. The keypoints for these images are found out and the distance between all the pair of keypoints are found out. This is called point set distance and if the point set distance of the input image and the gallery image match then the face will be recognized. This process is called Point Set Matching.

## VII. CONCLUSION

In this paper, we proposed a method for partial face recognition using robust point set matching. This method is used for aligning a patch face and the gallery image with each other even in the presence of the occlusions, change in the angle and the person, partial face of a person, change in the facial expressions of the person. Through the feature extraction and the keypoint selection, the keypoints in the face are detected both in the face

patch and the gallery image. The main keypoints are selected from a lot of keypoints and then they check the similarities between the two images present. The geometric information and the textual information is collected and then the point set distance matching is performed to find the matched image.

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