International Academy of Engineering and Medical Research, 2017
Volume-2, ISSUE-4
Published Online April 2017 in IAEMR (http://www.iaemr.com)

A Review on Partial Face Recognition System

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***Abstract*— A number of face recognition methods are used for identification or verification of a person in many computer applications. Most of the methods use images of entire face under controlled condition for face recognition. However, in many situations the human faces might be occluded by other object which poses a difficulty in face recognition. To overcome this problem, the proposed approach identifies the persons. From partial face, the proposed system tries matching it with the full faces available in the database. It first extracts local features that are textural features and geometrical features and also detect keypoints. Then a Robust Point Set Matching (RPSM) method is used to match local features sets and also keypoints of the faces from database and the partial face image under investigation. A distance metric is used to find similarity of the two faces using their two sets of features.**

Keywords - ***Face recognition, local feature set matching, partial face recognition.***

I. INTRODUCTION

The partial face is nothing but faces which contain facial expression, makeup, occluded by some object etc. Partial Face recognition means recognizing person of interest from partial face. The applications of partial face recognition are in forensics and in investigative environments, where only part of a face may be available. For example, body parts after an explosion, burn victims, and a photograph where only part of a face is visible etc. The challenging part of face recognition is in unconstrained environment where human faces might be occluded by other objects, and also in facial images with pose and illumination changes.

Face images may be natural face images or partial face images that is occluded by some object or it may contain facial expression, makeup etc. If the face image is natural face image then it is easy for person identification but if it is partial image then the performance of person identification is poor. Some examples of partial faces are shown in Fig. 1. So to improve performance of person identification the face recognition system is developed, which is able to recognize the partial face images from the gallery face image. The gallery images are nothing but the images which are stored in database, from which one can identify the person in partial face image.

To achieve this, local features are extracted from the partial and gallery face images. The local features contain textural features and geometrical features. The textural features are robust against in-plane rotation, scale, and illumination. The geometrical features record its position in the image plane. To extract these local features the Learned Arrangements of Three Patch Codes (LATCH) and the Scale Invariant Local Binary Pattern (SILBP) descriptors are used. The LATCH is used for extracting local features from an image and for detail description of facial textural features the SILBP is used. The results of these descriptors are combined, using simple concatenation.

Fig. 1. Partial face images

Afterword keypoint selection is used, which is nothing but the interest point. To remove outliers at the beginning and also used for calculating the ratio of the distances of the closest neighbor of the keypoint under considerations. The distance between two feature sets is expressed as the similarity of two faces. Keypoint selection is done using the Lowes matching method. Matched keypoint pairs are then selected by using Robust Point Set Matching (RPSM) algorithm.

In section II we are going to discuss about related work done for the proposed research area. In section III discuss about system architecture. Section IV is related to conclusion. And some references which are going to be use in section V.

II . RELATED WORK

Many existing Systems are available for partial face recognition system. Some of them are listed below:

C. Geng and X. Jiang [1] proposed Face Recognition based on the multi-scale local image structures. This system defines a framework for face recognition. It is based on Multi-scale local image structures with scale selection. SIFT descriptor is used for feature extraction and keypoints are selected using k-nearest neighbor rule. This system works well in visual object detection. But this system detect problem, if it is applied to recognition problem where the image database contain number of similar objects.

X. Cao et al [2] proposed Face Alignment by Explicit Shape Regression. This method is one of the new techniques for face alignment approach. This method uses techniques like cascaded regression, shape indexed features, adaptive shape constraint, and correlation based feature selection. This system presents a novel regression approach, which does not use any model for parametric shape. The adaptive shape constraint performs Principal Component Analysis (PCA) on all shape increments. This system experiments on the face data sets which contain near frontal faces captured in the lab environment, and it also contain large variation in occlusion, pose, expression, and illumination. It has high precision and good performance over time and also significantly improved performance in both the accuracy and the efficiency in real time applications. But in case of input images with side faces or large expressions, face alignment error is larger. This method fails when occluded facial images occur or in a high lighting conditions.

X. Zhu et al [3] proposed a unified approach to face detection, pose estimation, and Landmark estimation. In many real time applications there is a problem of finding and identifying human faces. So by using this system, the problem is overcome using three tasks such as detection of face, estimation of pose, and localization of landmark. This system is based on a mixture of trees with a shared pool of parts, for each facial landmark it defines a part. The system shows that tree structure model are more effective when capturing global elastic deformation. This system is efficiently optimized with dynamic programming, also it uses supervised data. But this method cannot handle large size of images and the partial face images. Also the speed of processing is slow, such as it takes more than 20 seconds.

X. Xiong et al [4] proposed Supervised Descent Method (SDM) and its applications to face alignment. To overcome disadvantages of second order descent method, this system proposed Supervised Descent Method (SDM) using supervised process generic descent directions. The use of SDM is in the problem of facial feature detection, face tracking, and in the analytic functions. It experiments on the data sets which contain facial expression, large variation in pose, illumination and also for the partial occluded face. The SDM demonstrate better performance in tracking faces in the databases and it also improves futuristic performance in face feature detection. But in an unconstrained environment, human faces might be occluded by other object. As the object size increases, the performance of face feature detection and face tracking will decrease. So by using this method, it is difficult to identify person when the object size is large.

J. Lu et al [5] proposed Discriminative Multi-manifold analysis for face recognition from a single training sample per person. This system is used in various real time applications such as in ID card, law enforcement. The proposed Novel Discriminative Multi-model Analysis (DMMA) Method uses the image patches from learning discriminative features. To form an image set for each image sample, it first partition each face image into non-overlapping patches. Then this system uses Single Sample Per Person (SSPP) face image recognition as a manifold-manifold matching problem and then uses various DMMA feature spaces for different images. And then it use reconstruction based manifold-manifold distance to recognize the unlabeled subjects. This system experiments on three different data sets, which contain different expression, pose, occlusions and also frontal face images. But in automatic face detection, the accuracy is affected.

R. Weng et al [6] proposed Robust Feature Set Matching for Partial Face Recognition. Many times human faces might be occluded by other object, so it is difficult to identify human faces. For this purpose, facial feature matching is computed to recognize persons of interest. To achieve this, the system proposed Metric Learned Extended Robust Point Matching (MLERPM) method to selective matched partial image to the gallery image. This system first extract local features using both SIFT and SURF keypoint descriptor. These descriptors are then combined, by using simple concatenation. To filter outliers at the beginning, the keypoint selection is done using Lowe's matching scheme. It compares the ratio of the distance of the closest neighbor, to a predefined threshold. Then to solve the problem of partial face images, the selected keypoint matched pair are then selected to the MLERPM for finer matching. This system is applicable for partial face or occluded face by other object, but as the object size increases more than 40%, then it is extremely difficult to match partial image to the image database.

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III. SYSTEM ARCHITECTURE

An image may be partial face image which is provided as an input to the system and the system will try to match the input image with the images present in the database. Fig. 2 is system block diagram.

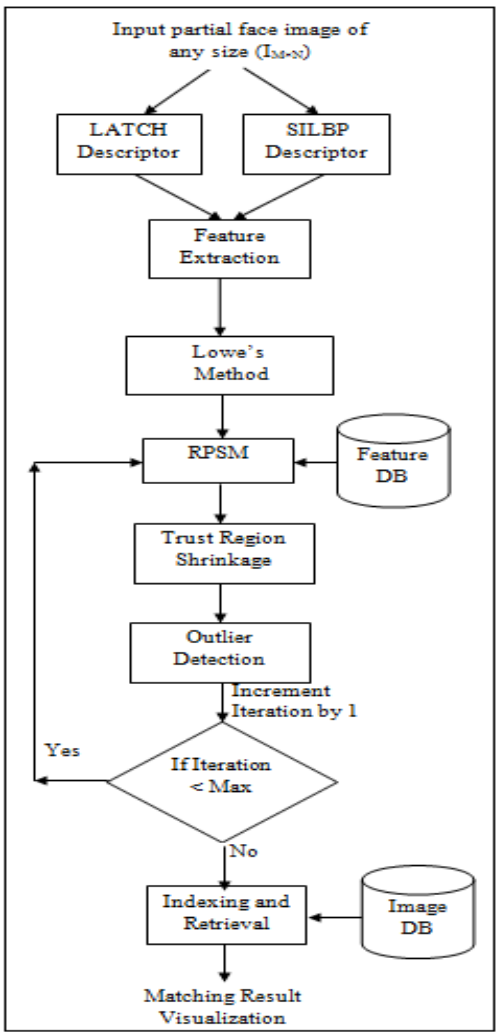

Fig 2: System architecture

Input Image: The input image may contain partial face image. Let partial face image is I of the size M×N.

Feature Extraction: For the input image, the keypoints are detected using LATCH and SILBP descriptor. Each keypoint contain geometric feature set and texture feature set. The geometric feature set, record its position in the image and the texture feature set record classification of texture of partial face image. The feature set of LATCH and SILBP descriptor is then combine using simple concatenation.

Lowe's Method: In feature extraction the number of keypoints is generated, it might be up to hundred, so the number of keypoint is too large. For better matching result, the minimum number of keypoint selection is done using Lowe's method. This method compares the ratio of the distance of nearest neighbor to one of the second closest nearest neighbor. To calculate ratio of distance, the threshold value is predefined that is 0.8 [10]. If the value is less than threshold value, then the keypoint is selected, for further matching process. By using this method, 90% of keypoints are rejected at the beginning. So the output of this method contain filtered feature vector, taht is texture feature set and geometric feature set. These filtered feature vector are then use by Robust Point Set Matching (RPSM) algorithm

RPSM: The Robust Point Set Matching (RPSM) algorithm uses an output of Lowe's method for the matching process of keypoint feature vector to the feature database. The RPSM algorithm contains three characteristics such as subset matching, one-to-one point correspondence, and non-affine transformation.

Trust Region Shrinkage: In this process, there might be a situation where all keypoint elements in the row/column of M binary correspondence matrix are close to 0. This situation occurs when an outlier has been detected and it will remove from M binary correspondence matrix. This process is not only for detecting and removing keypoints from the matching process, but also to improve matching accuracy.

Outlier Detection: In the outlier detection, the threshold value is set. If the summation of row/column of M is smaller than threshold value, then the row and its corresponding keypoint are removed from the matching process [7].

Indexing and Retrieval: The matching results of image are indexed from the face image database, and then retrieve as a result of partial face recognition.

IV. CONCLUSION

In this review paper, several existing techniques have studied and analysed in section II. Traditional method of face recognition using robust point set matching algorithm the partial face recognition system is proposed. It can be applicable in various areas like unconstrained environment, lighting condition, pose, and illumination. Partial face image which are captured in these conditions are easy to align using proposed method to its corresponding face image database. The non affine transformation plays an important role in matching keypoints of partial face image to the face image

database. For partial face recognition, the expected output is to display matched result.

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