RECOGNIZING AND MASK REMOVAL IN 3D FACES EVEN IN PRESENCE OF OCCLUSIONS

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Abstract

3D face recognition has the potential to achieve better accuracy than its 2D counterpart by measuring geometry of rigid features on the face. This avoids such pitfalls of 2D face recognition algorithms as change in lighting, different facial expressions, make-up and head orientation. Another approach is to use the 3D model to improve accuracy of traditional image based recognition by transforming the head into a known view. Then we consider 3D image for face recognition, Occlusions (extraneous objects that hinder face recognition e.g., scarf, glass, beard etc.,) are one of the greatest challenges in face recognition systems. We proposed our project under masked projection with high accuracy in face recognition system using classification algorithms. We propose a masked projection technique that can cope with missing data. Furthermore, we utilize a regional approach to improve the classification performance, where different regions serve as separate classifiers.

Keywords **-3D Face Recognition,3D Registration, Biometric Curvature Descriptor**

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

The purpose of image processing is divided into 5 groups. They are:

- Visualization - Observe the objects that are not visible
- Image sharpening and restoration - To create a better image
- Image retrieval - Seek for the image of interest.

- Measurement of pattern – Measures various objects in an image
- Image Recognition – Distinguish the objects in an image

Biometrics (or biometric authentication) refers to the identification of humans by their characteristics or traits. Biometrics is used in computer science as a form of identification and access control. It is also used to identify individuals in groups that are under surveillance. Biometric identifiers are the distinctive, measurable characteristics used to label and describe individuals. Biometric identifiers are often categorized as physiological versus behavioral characteristics. Physiological characteristics are related to the shape of the body. Examples include, but are not limited to fingerprint, face recognition, DNA, Palm print, hand geometry, iris recognition, retina and odour/scent. Behavioral characteristics are related to the pattern of behavior of a person, including but not limited to: typing rhythm, gait, and voice.

Face recognition using 3-D scans of the face has been recently proposed as an alternative or complementary solution to conventional 2-D face recognition approaches working on still images or videos. In fact, face representations based on 3-D data are expected to be much more robust to pose changes and illumination variations than 2-D images, thus allowing accurate face recognition also in real-world applications with unconstrained acquisition. Encouraged by these premises, many 3-D face recognition approaches have been proposed and experimented in the last few years. In a conventional face recognition experiment, it is assumed that both the probe and gallery scans are acquired cooperatively in a controlled environment so as to precisely capture and represent the whole face. Many of the existing methods followed this assumption, focusing on face recognition in the presence of expression variations and reporting very high accuracy on benchmark databases like the Face Recognition Grand Challenge.

Differently, solutions enabling face recognition in uncooperative scenarios are now at tracing an increasing interest. In such a case, probe scans are acquired in unconstrained conditions that may lead to *missing parts*, or to *occlusions* due to hair, glasses, scarves, hand gestures, etc. These difficulties are further sharpened by the recent advent of 4-D scanners (3-D plus time) capable of acquiring temporal sequences of 3-D scans. In fact, the dynamics of facial movements captured by these devices can be useful for many applications, but also increases the acquisition noise and the variability in subjects' pose. In summary, despite the research and applicative importance that *partial face matching* solutions are gaining, just a few works have explicitly addressed the problem of 3-D face recognition in the case in which some parts of the facial scans are missing.

A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems. Three-dimensional face recognition (3D face recognition) is a modality of facial recognition methods in which the three-dimensional geometry of the human face is used. It has been shown that 3D face recognition methods can achieve significantly higher accuracy than their 2D counterparts, rivaling fingerprint recognition.

II. RELATED WORK

Developments in 3-D sensor technologies have increased interest in 3-D face recognition.
3-D face, it is possible to obtain competitive results when compared with other modalities such as iris and high-resolution 2-D facial images. A thorough survey of previously proposed 3-D face recognition both in 2-Dand 3-D.

2-D TECHNIQUES

Although variations caused by pose and expression have attracted increased research effort, the problem of handling occlusions has not been discussed frequently. In the 2-D face recognition studies, there has been a few approaches considering occlusion variations. In most of these studies, the aim is occlusion handling for recognition and the registration problem is not considered: Experimental results are usually reported on databases where the faces are assumed to be accurately registered prior to recognition.
Some studies are based on subspace analysis methods, where the aim is either occlusion-robust projection or missing data compensation.

consider occlusions caused only by eyeglasses and propose a method to compensate for the missing data. Initially, the glasses region is extracted using color and edge information. The offline-generated eigenfaces from a set of non occluded images are then used together with the extracted glasses region for missing data compensation.

III. EXISTING SYSTEM

NORMALIZATION

The feature extraction module finds the possible facial features which presents the occluded regions.Once the artificial occlusion is generated, the Next step normalization is carried out. Wavelet Normalization is used for this purpose. This method is efficient for illumination and pose conditions. It first decomposes the image into its low frequency and high frequency components.In the two-band multi-resolution wavelet transform, signal can be expressed by wavelet and scaling basis functions at different scale, in a hierarchical manner.

FEATURE EXTRACTION

The Facial features are extracted from the Normalized facial image. This is done by the dual tree complex wavelet transform. This provides a direct multi resolution decomposition of a given image. This method works well for the direct upright frontal images. Frontal images are already obtained by the wavelet normalization method which is already described. The desirable characteristics of the DT-DWT(S) such as spatial locality, orientation selectivity and excellent noise cleaning performance provides a framework which renders the extraction of facial features almost invariant to such disturbances. The norm of complex directional wavelet sub band coefficients is used to create a test statistics for enhancing the facial feature edge points. The Rayleigh distribution of the derived statistics matches very closely with the true coefficient distribution in the 6 directional sub bands. The use of the complex wavelet transform helps to detect more facial feature edge points due to its improved directionality. Additionally, it eliminates the effects of non-uniform illumination very effectively . By combining the edge information obtained by using DT-DWT(S) and the non-skin areas obtained from the skin color statistics, the facial features can be extracted.

FACE RESTORATION

The facial feature extraction provides the necessary information for subsequent face restoration and recognition process. The key idea in restoration is to use the available information provided by the facial feature extraction. For this a preliminary mask is computed by calculating Distance From Feature Space(DFFS), by thresholding vector ‘e’. This results in the preliminary mask calculation.

FACE RECOGNITION

The method used for face recognition is Average Regional Model (ARM). The aim of the method is to find regional correspondences between any two face. It consists of the following steps,
i) coarse and dense ARM-based registration,
ii) region-based matching, and iii) classifier fusion. Global coarse registration is carried out to roughly align a given 3D face image to the AFM. ARMs are constructed on the AFM by determining the semantic regions manually. The whole facial model is divided into four parts: eye-forehead, nose, cheeks, and mouth-chin regions. Dense registration is carried out by aligning local regions with ARMs using the ICP algorithm. Each region over the test face is registered to its corresponding average regional model separately. Registered regions are then regularly resampled. Therefore, after local dense registration, facial components are automatically determined over the given facial surface.

3D FEATURE EXTRACTION

The range images provided by the FRGC consist of texture-range data pairs consistently registered: each pixel on the texture image is associated to its 3D point in the range data, making straightforward the determination of the 3D coordinates associated to any point in the 2D image. which correspond to a segment connecting points automatically determined in the texture image.This recognition method provides efficient results for faces with occlusions and expressions.

Fig. 1. Left: Set of the 2D _ducial points; Right: Set of segments considered to generate the 3D

IV. PROPOSED SYSTEM

This work introduces a new technique called *masked projection* for subspace analysis with incomplete data. We use the system outlined in The preprocessing module includes the registration and occlusion removal steps. For alignment, the adaptive registration module1 of is utilized, which registers the occluded surfaces. By adaptively selecting the model, it is possible to discard the effect of occluding surfaces on registration.

The occlusions are detected on the registered surfaces by thresholding point distances to an average face model. The training module works offline to learn the projection matrices from the training set of nonoccluded faces for different regions.The classification module uses the occlusion mask of the probe image to compute the masked projection, and projects the probe image to the adaptive subspace. The identification is handled in the subspace by 1-nearest neighbour (1-NN) classifier. The proposed system is evaluated on two main 3-D face databases that contain realistic occlusions: (1) The Bosphorus, and (2) the UMB-DB databases.

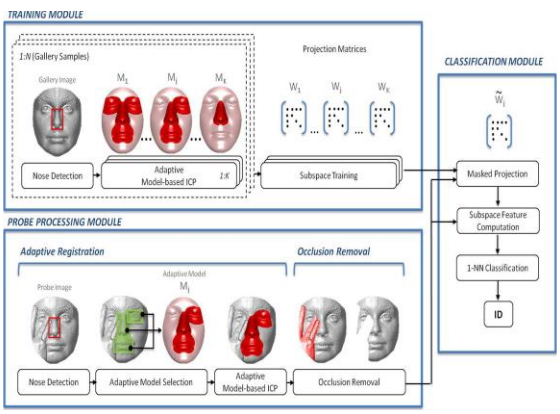

Fig.2.Illustrative diagram of the proposed 3-D face recognition approach.

MODEL SELECTION

This module we use the Iterative closest point algorithm which is one of the most preferred methods for rigid registration of 3D surfaces. Iterative Closest Point (ICP) is an algorithm employed to minimize the difference between two clouds of points. ICP is often used to reconstruct 2D or 3D surfaces from different scans, to localize robots and achieve optimal path planning (especially when wheel odometry is unreliable due to slippery terrain), to co-register bone models, etc. We employ the model based registration approach which can cope with occlusion variations.

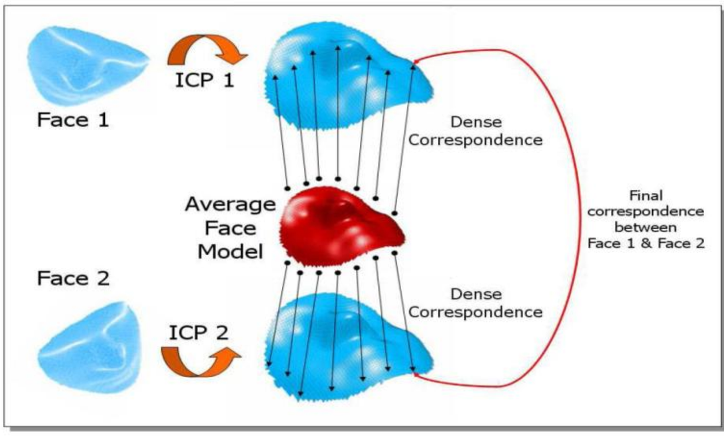

Fig.3.Diagram For Iterative Closest Point

MASK PROJECTION

This module we analyze the remove extra pixels that are not present in the gallery image and these pixels are known as occlusion pixels. Analyze the subspace points and give the nodal points. In this module we analyze the non occlusion points and perform the occlusion removal process.

LAPLACIAN ALGORITHM

The laplacian algorithm used to calculate the nodal points. Each nodal points have some of weighted values. The weighted values of probe image nodal points match with gallery image. Perform classification to check the incomplete data Provide the perfect image(Face). The classification task analyzes the all nodal points that are match with test images. Finally produce the correct person face image

Facial recognition systems are built on computer programs that analyze images of human faces for the purpose of identifying them. The programs take a facial image, measure characteristics such as the distance between the eyes, the length of the nose, and the angle of the jaw, and create a unique file called a "template." Using templates, the software then compares that image with another image and produces a score that measures how similar the images are to each other. Typical sources of images for use in facial recognition include video camera signals and pre-existing photos such as those in driver's license databases.

Facial recognition systems are computer-based security systems that are able to automatically detect and identify human faces. These systems depend on a recognition algorithm, such as eigenface or the hidden Markov model. The first step for a facial recognition system is to recognize a human face and extract it for the rest of the scene. Next, the system measures nodal points on the face, such as the distance between the eyes, the shape of the cheekbones and other distinguishable features.

These nodal points are then compared to the nodal points computed from a database of pictures in order to find a match. Obviously, such a system is limited based on the angle of the face captured and the lighting conditions present. New technologies are currently in development to create three-dimensional models of a person's face based on a digital photograph in order to create more nodal points for comparison. However, such technology is inherently susceptible to error given that the computer is extrapolating a three-dimensional model from a two-dimensional photograph.

Laplacian is an algorithm to smooth a polygonal mesh. For each vertex in a mesh, a new position is chosen based on local information (such as the position of neighbors) and the vertex is moved there. In the case that a mesh is topologically a rectangular grid (that is, each internal vertex is connected to four neighbors) then this operation produces the Laplacian of the mesh. More formally, the smoothing operation may be described per-vertex as:

$$\bar{x}_i = \frac{1}{N}\sum_{j=1}^{N} x_j$$

Where N is the number of adjacent vertices to node i and $\bar{x}_i$ is the new position for node i

With its neighborhood preserving character, the Laplacian faces seem to be able to capture the intrinsic face manifold structure to a larger extent.

Figure shows an example that the face images with various pose and expression of a person are mapped into two-dimensional subspace. The face image dataset used here is the same. This dataset contains 1965 face images taken from sequential frames of a small video. The size of each image is 20×28 pixels, with 256 gray levels per pixel. Thus, each face image is represented by a point in the 560-dimensional ambient space. However, these images are believed to come from a sub manifold with few degrees of freedom. We leave out 10 samples for testing, and the remaining 1955 samples are used to learn the Laplacian faces. As can be seen, the face images are mapped into a two-dimensional space with continuous change in pose and expression.

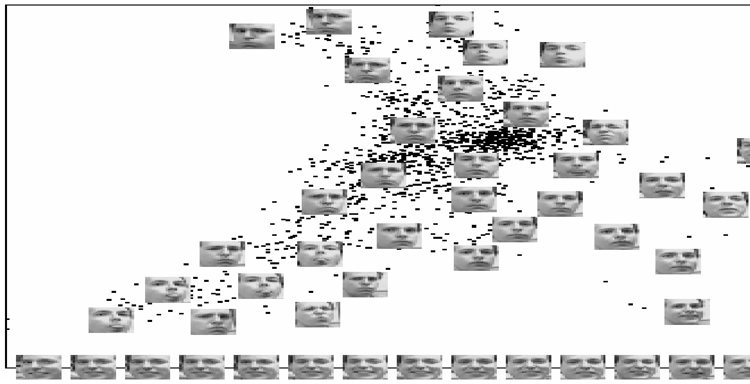

Fig.4. Face images with various pose and expression

The representative face images are shown in the different parts of the space. The face images are divided into two parts. The left part includes the face images with open mouth, and the right part includes the face images with closed mouth. This is because in trying to preserve local structure in the embedding, the Laplacian faces implicitly emphasize the natural clusters in the data. Specifically, it makes the neighboring points in the image face nearer in the face space, and faraway points in the image face farther in the face space. The bottom images correspond to points along the right path (linked by solid line), illustrating one particular mode of variability in pose.

V. CONCLUSIONS

3D face recognition has matured to match the performance of 2D face recognition. When used together with 2D, it makes face a very strong biometric: Face as a biometric modality is widely acceptable for the general public, and face recognition technology is able to meet the accuracy demands of a wide range of applications. While the accuracy of algorithms have met requirements in controlled tests, 3D face recognition systems have yet to be tested under real application scenarios. For certain application scenarios such as surveillance system and access control, systems are being tested in the field. The algorithms in these application scenarios will need to be improved to perform robustly under various occlusion and masked projection. The proposed system is able to work with good performance under substantial occlusions, expressions, and small pose variations. When we examine the failures, we see that if occlusions are so large that the nose area is totally invisible, the initial alignment becomes impossible. Similarly, if the face is rotated by more than 30 degrees, it becomes difficult to accomplish the initial alignment.

VI. REFERENCES

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