IJCSE International Journal of Computer Sciences and Engineering Open Access
Review Paper Volume-3, Issue-5 E-ISSN: 2347-2693

Robust 3D Face Recognition

Vengatesh R[1*] and Rajbarath[2]

[1,2]*Department of Computer Science and Engineering,*
Sri Manakula Vinayagar Institute of Technology, India

www.ijcseonline.org

Received: 04 May 2015 Revised: 12 May 2015 Accepted: 26 May 2015 Published: 30 May 2015

Abstract— Robustness of face recognition systems are measured by its ability to overcome the problem of changing in facial expression and rotation of individuals' face images. This paper represents a face recognition system that overcomes the problem of changes in facial expressions in three-dimensional (3D) range images. We propose a novel geometric framework for analyzing 3D faces, with the specific goals of comparing, matching, and averaging their shapes. Here we represent facial surfaces by radial curves emanating from the nose tips and use elastic shape analysis of these curves to develop a Riemannian framework for analyzing shapes of full facial surfaces. A novel perception inspired non-metric partial similarity measure is introduced, which is potentially useful in deal with the concerned problems because it can help capturing the prominent partial similarities that are dominant in human perception. The effectiveness of the proposed method in handling large expressions, partial occlusions and other distortions is demonstrated on several well-known face databases.

***Keywords*—**SOM, 3D face

I. INTRODUCTION

The need of security and fraud control applications to establish personal authentication has caused the increase of research in biometric systems. Automatic face recognition has received a great deal of attention and emerged as an active research area especially over the last 20 years. The major purpose of face recognition is to identify the humans from data acquired from their faces, as humans do. A good recognition system has to be fully automatic and robust enough for real life conditions such as illumination, rotations, expressions and occlusions.

Face detection and recognition system has to attribute a unique identity to each face by matching it to a large database of persons even in the presence of such image acquisition problems as camera distortion, noise and low image resolution. Despite these rigid design specifications, one needs to maintain the usability of the system on contemporary computational devices. In other words, the processing involved should be efficient with respect to run-time and storage space.

Most research efforts have concentrated on recognizing a human face from two-dimensional (2D) images, recently three dimensional (3D) approaches have been receiving more attention. Even though the latest 2D face recognition systems have achieved good performance in constrained environments, they are still unable to deal with such problems as changes in head poses and illumination conditions. Since the human face is a 3D object whose 2D image projection is sensitive to these changes, utilizing the 3D face information can improve the face recognition performance considerably. Further, 3D measurements help solving scale, illumination, and rotation problems encountered in 2D analysis.

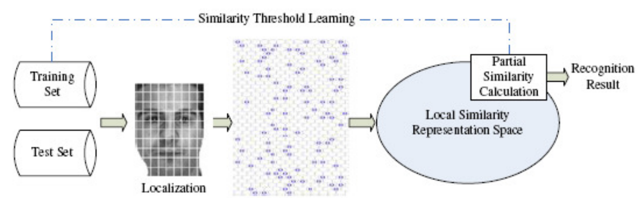

Figure 1 Architecture

Existing face recognition techniques have demonstrated the capability of invariance to facial variations caused by illumination and have achieved high accuracy rates. To make the recognition process illumination invariant, phase congruency feature maps are used instead of intensity values as the input to the face recognition system. The feature selection process presented in this paper is derived from the concept of modular spaces. Recognition techniques based on local regions have achieved high accuracy rates. Though the face images are affected due to variations such as no uniform illumination, expressions and partial occlusions, facial variations are confined mostly to local regions. Modularizing the images would help to localize these variations, provided he modules created are sufficiently small. But in this process, large amount of dependencies among various neighboring pixels might be ignored. This can be countered by making the modules larger, but this would result in an improper localization of the facial variations.

II. BACKGROUND REVIEW

In paper, we present a novel approach to 3D face matching that shows high effectiveness in distinguishing facial differences between distinct individuals from differences induced by non-neutral expressions within the same individual. The approach takes into account geometrical information of the 3D face and encodes the relevant information into a compact representation in the form of a graph. Nodes of the graph represent equal width iso-geodesic facial stripes. Arcs between pairs of nodes are labeled with descriptors, referred to as 3D Weighted Walkthroughs (3DWWs), that capture the mutual relative spatial displacement between all the pairs of points of the corresponding stripes. Face partitioning into iso-geodesic stripes and 3DWWs together provide an approximate representation of local morphology of faces that exhibits smooth variations for changes induced by facial expressions. The graph-based representation permits very efficient matching for face recognition and is also suited to be employed for face identification in very large datasets with the support of appropriate index structures. The method obtained the best ranking at the SHREC 2008 contest for 3D face recognition. We present an extensive comparative evaluation of performance with the FRGC v2.0 dataset and the SHREC08 dataset.

This paper explores the representation of the human face by features based on shape and curvature of the face surface. Curvature captures many features necessary to accurately describe the face such as the shape of the forehead. And cheeks which are not easily detected from standard intensity images Moreover the value of curvature at a point on the surface is also viewpoint invariant. Until recently range data of high enough resolution and accuracy to perform useful curvature calculations on the scale of the human face had been unavailable. Although several researchers have worked on the problem of interpreting range data from curved although usually highly geometrically structured. Surfaces the main approaches have centered on segmentation by signs of mean and Gaussian curvature which have not proved sufficient for classification of human faces. This paper details the calculation of principal curvature for our particular data set the calculation of general surface descriptors based on curvature and the calculation of face specific descriptors based both on curvature features and a priori knowledge about the structure of the face. These face specific descriptors can be incorporated into many different recognition strategies. We describe a system which implements one such strategy depth template comparison giving excellent recognition rates in our test cases.

This paper presents an innovative three dimensional occlusion detection and restoration strategy for the recognition of three dimensional faces partially occluded by unforeseen, extraneous objects. The detection method considers occlusions as local deformations of the face that correspond to perturbations in a space designed to represent non-occluded faces. Once detected, occlusions represent missing information, or "holes" in the faces. The restoration module exploits the information provided by the non-occluded part of the face to recover the whole face, using an appropriate basis for the space in which non-occluded faces lie. The restoration strategy does not depend on the method used to detect occlusions and can also be applied to restore faces in the presence of noise and missing pixels due to acquisition inaccuracies. The strategy has been experimented on the occluded acquisitions taken from the Bosphorus 3D face database. A method for the generation of real-looking occlusions is also presented. Artificial occlusions, applied to the UND database, allowed for an in-depth analysis of the capabilities of our approach. Experimental results demonstrate the robustness and feasibility of our approach.

III. 3D FACE RECOGNITION

The overall architecture of the proposed method is enable the capture of the partial similarity and the integration of the spatial information, face images are partitioned into local facial regions (sub-blocks) at first. Then, all the sub-blocks are mapped into an SOM topological space to obtain a compact and robust representation, where the nearest neighbor search is performed using the proposed partial distance measure, and the training face image with the smallest partial distance to the probe face image is selected to give the final identity.

A. Phase congruency feature: (Loading faces from training set)

Image features such as step edges and lines give rise to points where the Fourier components of the image are maximally in phase. According to Oppenheim and Lim, the phase component is more important than the magnitude component in the reconstruction process of an image from its Fourier domain. There is also physiological evidence, indicating that the human visual system responds strongly to the points in an image where the phase information is highly ordered. Application of PCA-based recognition technique on the phase spectrum of the images resulted in better performance than on the application of intensity images and the magnitude spectrum.

B. Division of modules(Dividing Similar faces)

Local facial variations caused by expressions, makeup, etc., can be dealt more effectively by considering a Voronoi region-based feature extraction approach. This can improve the classification ability. Dividing the images into sufficiently smaller modules would help in localizing the facial variations.

C. Neighbourhood partial similarity (identifying faces)

Smaller Voronoi-regions from a predefined neighborhood within the phase congruency images of the training samples are merged to obtain a large set of modules. As variations in face images are confined to local regions, it is possible to consider additional pixel dependencies across various sub-regions and also to localize the variations by merging the modules. This helps in improving the classification accuracy.

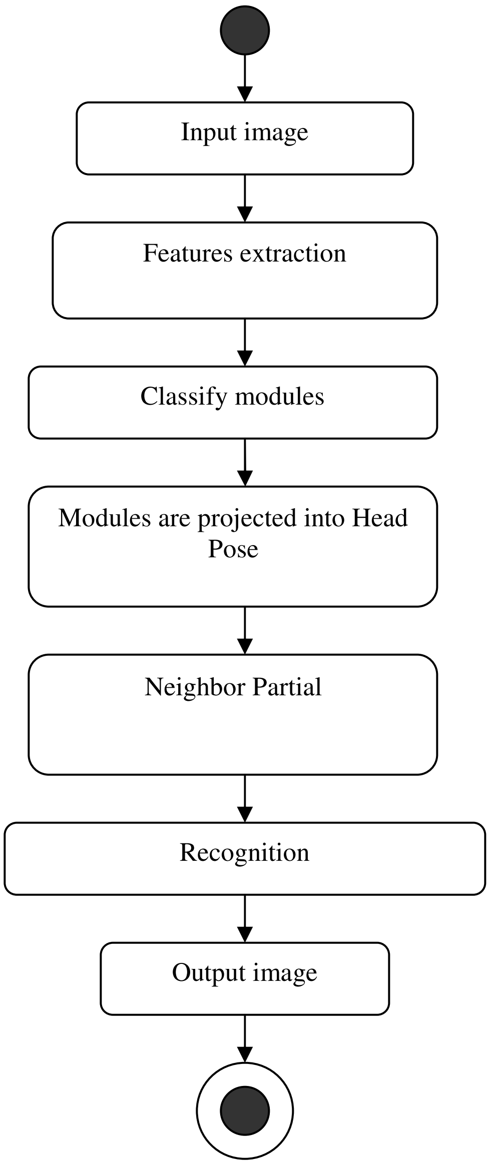

Figure 2 Flow of the architecture

We present two similarity threshold setting strategies to distinguish the most useful image patches from those less useful ones, based on a local similarity representation of face images. The first strategy is based on the golden section rule which empirically excludes less useful portions from recognition, while the other is based on the maximum marginal criterion, allowing one to learn the optimal intra-personal partial similarity for each class. The feasibility and effectiveness of these two strategies is verified by a series of experiments on several well-known face databases. It is found that partial similarity matching performs better than several other methods in handling expression variations, partial occlusions and other local distortions.

IV. FACE RECOGNITION

We proposed to automatically set the similarity threshold. The effectiveness of the proposed method in handling large expressions, partial occlusions and other distortions is demonstrated on several well-known face databases. By training, the CSGPR algorithm can produce a topological ordering of the feature map in the input space in the sense that neurons that are adjacent in the lattice will tend to have similar weight vectors. This is one of the most important properties of the CSGPR; hence the CSGPR grid is commonly called the topological space. More than that, each Voronoi region actually defines a deformable subspace in the input space, since all the sub-blocks falling in the same Voronoi region would be finally mapping to the same neuron in the CSGPR automatically set the similarity threshold. The effectiveness of the proposed method in handling large expressions, partial occlusions and other distortions is demonstrated on several well-known face databases.

V. CONCLUSION

The Future enhancement can be presented here an innovative strategy for the restoration of partially occluded 3D faces. Since it is independent of the recognition algorithm, our strategy can improve the reliability with respect to occlusions of any 3D recognition system, even when low computational resources are available (occlusion detection and restoration require an average of 0.24 seconds to process a face on a modern personal computer). The restoration strategy is independent of the method used to detect occlusions and can also be applied to restore faces in the presence of noise, self-occlusions, and acquisition artifacts.
Experimentation has been conducted on an artificially occluded dataset which we plan to make available (or, at least, we will release the tool for automatic occlusions generation) and on the real occluded acquisitions from the Bosphorus database. We plan to acquire a larger number of faces with real occlusions to further demonstrate the applicability of our method. Since occlusion in 3D face recognition is an unexplored topic, we cannot state that the restoration strategy is the optimal solution in terms of recognition accuracy. Even if restoration will be proven to be suboptimal, occlusion detection would still be a useful and valuable component in 3D recognition system pipelines. Other authors reported an improved invariance with respect to facial expressions when dealing with occlusions in face recognition. Our method is not expected to provide high accuracy in the case of emphasized facial expressions. However, we plan to investigate a similar restoration

approach: expressions would be classified and "neutralized" before recognition.

REFERENCES

[1] The Biometric Consortium, http://www.biometrics.org.
[2] A. Pentland and T. Choudhury, "Face Recognition for Smart Environments", Computer IEEE, February 2000, 50-55.
[3] R. Chellappa, C.L. Wilson, and S. Sirohey, Human and Machine Recognition on Faces: A Survey. Technical Report CAR-TR-731, Computer Vision Laboratory, University of Maryland, 1994.
[4] T. Kanade, Picture Processing System by Computer Complex and Recognition of Human Faces, Ph.D. Thesis. Kyoto University, Japan, 1973.
[5] C. Chua, F. Han, and Y. Ho, "3D human face recognition using point signature," Proceedings of the 4th IEEE International Conference on Automatic Face and Gesture Recognition, pp. 233-239, 2000.
[6] B. Weyrauch, B. Heisele, J. Huang, and V. Blanz. "Component-based face recognition with 3D morphable models," Conference on Computer Vision and Pattern Recognition Workshop, Vol. 5, No. 5, p. 85, 2004.
[7] L. Ma, D. Chelberg, and M. Celenk, "Spatio-Temporal Modeling of Facial Expressions Using Gabor-Wavelets and Hierarchical Hidden Markov Models," IEEE International Conference on Image Processing (ICIP), Vol. 2, pp. 57-60, 2005.
[8] A. Rajwade, Facial Pose Estimation and Face Recognition from Three- Dimensional Data, MS Thesis. McGill University, August 2004.
[9] K. W. Bowyer, K. Chang, and P. Flynn, A Survey Of 3Dand Multi-Modal 3D+2D Face Recognition, Notre Dame Department of Computer Science and Engineering Technical Report, January 2004.
[10] K. Lin, "On improvement of the computation speed of Otsu's image thresholding," Journal of Electronic Imaging, Vol. 14, No. 2, 2005.

