http://ansinet.com/itj

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 6 (7): 1075-1079, 2007
ISSN 1812-5638

Automatic 3D Face Model from 2D Image-Through Projection

[1]Sushma Jaiswal, [2]Sarita Singh Bhadauria and [3]Rakesh Singh Jadon
[1]Department of MCA, UIT, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, MP-462036, India
[2]SOIT, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, MP-462036, India
[3]Department of MCA, MITS Gwalior, MP-474005, India

Abstract: In the proposed study, 2D photographs image divided into two parts; one part is front view (x, y) and side view (y, z). Necessary condition of this method is that position or coordinate of both images should be equal. We combine both images according to the coordinate then we will get 3D Models (x, y, z) but this 3D model is not accurate in size or shape. In defining other words, we will get 3D animatable face, refinement of 3D animatable face through pixellization and smoothing process. Smoothing is performed to get the more realistic 3D face model for the person.

Key words: Automatic face model, projection, smoothing, pixellization, application, 2D image, 3D image

INTRODUCTION

For the past few years, a number of new face recognition techniques have been proposed. We propose new techniques that include face recognition from three-dimensional (3D) projection. Automatic face recognition (AFR) has long been one of the most active research areas in computer vision. In the last two decades a vast number of different AFR algorithms have been developed-(Moghaddam *et al*., 1998; Belhumeur *et al*., 1997; Kepenekci, 2001) and the 3D morphable model (Blanz *et al*., 2003; Romdhani *et al*., 2002), to name just a few popular ones. These methods have achieved very good accuracy on a small number of controlled test sets.

Bledsoe (1966a) described the following difficulties in face recognitions: this recognition problem is made difficult by the great variability in head rotation and tilt, lighting intensity and angle, facial expression, aging, etc. Some other attempts at facial recognition by machine have allowed for little or no variability in these quantities. Yet the method of correlation (or pattern matching) of unprocessed optical data, which is often used by some researchers, is certain to fail in cases where the variability is great. In particular, the correlation is very low between two pictures of the same person with two different head rotations. This presents a fast technique for creating 3D model of a human face from two pictures of a face, one from the front and the other from side.

Such technique can have many applications, ranging from user interface improvement to video-conferencing, medical image analysis, aerial photo interpretation, vehicle exploration and mobility, material handling for example, part sorting and picking, inspection for example, integrated circuit board and chip inspection, assembly, navigation etc. Thus, optimized algorithms for 3D face recognition form 2D image thorough projection are enquired for real-life applications that are submitted to strong efficiency constraints. Our ultimate goal is the design of a 3D face recognition system that is automated.

Franc *et al*. (2002) proposed 2d vs 3d color space face detection For better human computer interaction it is necessary for the machine to see people. This can be achieved by employing face detection algorithms, like the one used in the installation 15 sec of Fame. Mentioned installation unites the areas of modern art and technology. Its algorithm is based on skin colour detection. One of the problems this and similar algorithms have to deal with is sensitivity to the illumination conditions under which the input image is captured. Hence illumination sensitivity influences face detection results.

Sun *et al*. (2005) proposed a 3D face recognition using two views face modeling and labeling in this study use a generic model to label the 3D facial features. This approach relies realistic face modeling technique, by which the individual face model is created using a generic model and two views of a face. In the individualized model and label the facial features by their maximum and minimum curvatures. Among the labeled features, the good features are selected by using a Genetic Algorithm based approach. The feature space is then formed by using these new 3D shape descriptors and each individual face is classified according to its feature space correlation.

Corresponding Author: Sushma Jaiswal, Department of MCA, UIT, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, MP-462036, India Tel: +91-9229578508

Irfanoglu *et al.* (2004) proposed 3D Shape-based Face Recognition using Automatically Registered Facial Surfaces, in this method authors address the use of three dimensional facial shape information for human face identification. Fine registration of facial surfaces is done by first automatically finding important facial landmarks and then, establishing a dense correspondence between points on the facial surface with the help of a 3D face template-aided thin plate spline algorithm. After the registration of facial surfaces, similarity between two faces is defined as a discrete approximation of the volume difference between facial surfaces. Proposed algorithm performs as good as the point signature method and it is statistically superior to the point distribution model-based method and the 2D depth imagery technique. In terms of computational complexity, this algorithm is faster than the point signature method.

Park *et al.* (2005) proposed 3D Model-Assisted Face Recognition in Video which contains temporal information as well as multiple instances of a face, so it is expected to lead to better face recognition performance compared to still face images. However, faces appearing in a video have substantial variations in pose and lighting. The system utilizes the rich information in a video and overcomes the pose and lighting variations using 3D face model.

Tsalakanidou *et al.* (2003) report on multi-modal face recognition using 3D and color images. The use of color rather than simply gray-scale intensity appears to be unique among the multi-modal work surveyed here. Results of experiments using images of 40 persons from the XM2VTS dataset Tsalakanidou *et al.* (2005) are reported for color images alone, 3D alone and 3D + color. The recognition algorithm is PCA-style matching, followed by a combination of the results for the individual color planes and range image.

METHODS COMPARISON: RANGE IMAGE AND WITHOUT RANGE IMAGE

First, we describe methods which have been used for restoring (acquiring) geometrical data considering only shape. Second gives methods where reconstruction is done to acquire both shape and structure.

Shape reconstruction: To get a detailed matched shape, we need time-consuming manual job, a sophisticated equipment, or complicated algorithm. Most of them need one more process to get structured shape for animation. In this section we focus on a few methods to get detailed range data for face.

Plaster model: Thalmann *et al.* (1987) used plaster models in real world and selected facets and vertices marking on the models which are photographed from various angles to be digitized. Here the reconstruction approach requires a mesh drawn on the face and is time consuming, but can obtain high resolution in any interested area.

Laser scanning, range image vision system some sensors, such as scanners, yield range images. For each pixel of the image, the range to the visible surface of the objects in the scene is known. Therefore, spatial location is determined for a large number of points on this surface. An example of commercial 3D digitizer based on laser-light scanning, is Cyber ware Color Digitizer TM. Lee *et al.* (1996) digitized facial geometry through the use of scanning range sensors. However, the approach based on 3D digitization requires special high-cost hardware and a powerful workstation.

Stripe generator: As an example of structured light camera range digitizer, a light striper with a camera and stripe pattern generator can be used for face reconstruction with relatively cheap equipment compared to laser scanners. Stripe pattern is projected on the 3D object surface and it is taken by a camera. With information of positions of projector and camera and stripe pattern, a 3D shape can be calculated. Proesmans *et al.* (1997) shows a good dynamic 3D shape using a slide projector, by a frame-by-frame reconstruction of a video.

Lighting switch photometry: Lighting switch photometry uses three or more light sources for computing normal vectors for extracting shapes of static objects as discuss by Coleman *et al.* (1982). This method assumes that the reflectance map is Lambertian. By Lighting Switch Photometry, the normal vector can be computed at the points where three incident light sources illuminate. It is difficult to compute the accurate normal vector at the point where the intensity of radiance is small, such as shadowed regions.

Stereoscopy: A distance measurement method such as stereo can establish the correspondence at certain characteristic points. The method uses the geometric relation over stereo images to recover the surface depth. The method usually results in sparse spatial data. Fua and Leclerc (1996) used it mainly in textured areas by weighting the stereo component most strongly for textured image areas and the shading component most strongly for texture-less areas.

Structured shape reconstruction: Most of the above methods concentrate on recovering a good shape, but the biggest drawback is that they provide only the shape without structured information. To get a structured shape for animation, most typical way is to modify an available generic model with structural information such that eyes, lips, nose, hair and so on. We classify methods using range data 1 and without using range data.

The plaster marking method by Magnenat Thalmann *et al.* (1987) mentioned structure for animation because each point has its own labeling corresponding to animation model. Except in this method, it is necessary to add structural information to a set of 3D points to make the model suitable for animation.

Williams (1990) reconstructed a head using Cyberware TM digitizer and applied warp ware to animate the model. A set of warping kernels is distributed around the face, each of which is a Hanning (cosine) window, scaled to 1.0 in the center and diminishing smoothly to 0.0 at the edge.

The approach based on 3D digitization to get a range data often requires special purpose high-cost hardware. So a common way of creating 3D objects is reconstruction from 2D information which is accessible at low price. Two commonly used methods are an interactive deformation method which modifies or generates a surface employing deformation and a reconstruction method with feature points which modifies a generic model after feature detection.

Magnenat Thalmann *et al.* (1995) used an interactive tool to generate a polygon mesh surface for creating figures. The major operations performed include creation of primitives, selection, local deformations and global deformations. It is more tedious and time consuming. However, it may be only possible way to digitize a historical personage whose pictorial or other source is not available and is useful to invent new characters.

Reconstruction with feature points there are faster approaches to reconstruct a face shape from few pictures of a face (Horace *et al*., 1996; Takaaki *et al.*, 1993). In this method, a generic model in 3D is provided in advance and a limited number of feature points are detected either automatically or interactively on the two (or more) orthogonal pictures and the other points on the generic model are modified by a special function. Then 3D points are calculated by just combining several 2D coordinates.

Kurihara *et al.* (1991) used an interactive method to get a few points and a Delaunay triangulation for the conformation of the face and texture mapping. The result seems nice, but a big drawback is that they use too few points to modify the generic model. So if the generic model has very different shape, the result may not be similar to the person and texture mapping may also not work well. To increase accuracy, one should increase input points for modification of generic model, very similar approach to the one of Akimoto *et al.* (1993). These approaches tried to detect feature points automatically using dynamic template matching or LMCT (Local Maximum-Curvature Tracking) checking concave and convex points on the side profile of a face and a very simple filtering method to get interior points. It was a trial for automation, but the method they use to detect points does not seem to be very robust. In addition LMCT was designed to calculate convex or concave points which works well only for Mongoloid looking people.

A 3D morphable model is used to compute 3D face models. The face orientation and illumination causes the face recognization not very easy in real application. Huang *et al.* (2002) provides the face recognition method based on 3D morphable model. In this method, a 2D face image is matched to 3D face model which can be morphed according to some parameter. The face recognition can be applied according to those parameters. For any given face image, we should map 2D image to the 3D face models before face recognization. The project used PCA eigenface method to match 2D image to 3D face model.

PROPOSED METHOD

In this study, proposed novel method of 3D face recognition can be stated in following steps (Fig. 1).

- **Front view and side view:** Both views of face are captured in such a manner that the horizontal distance of front view and side view are same. The images should be in the same size (i.e., same pixel size). During capturing the side view care should be taken that the side view is perpendicular to the horizontal line front view.
- **Face extraction:** The face is extract from the front view in such a manner that the vertical dimension of the face from the front view and side view should be same and horizontal dimension of side view should cover the face.
- **Pixellization:** The extracted images of faces are then pixellized. This pixel indicates the points on images and each point has an identical coordinate from any reference line.
- **Getting coordinate through projection of front view (x, y):** In this step, x coordinates are taken from the extracted image of front view taking reference of left or right border of the image and y coordinate are taken from bottom border of image. Each pixel of the front view can be identified by the set of x and y coordinates.

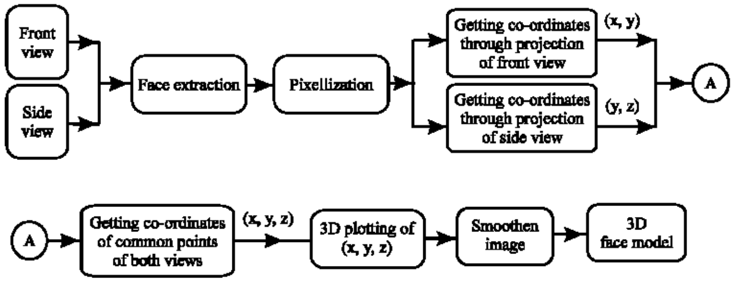

Fig. 1: Architecture of proposed work

- **Getting coordinates through projection of side view (y, z):** In this step, z coordinates are taken from the extracted image of side view taking reference of right border of the image and y coordinate are taken from bottom border of image. Each pixel of the side view can be identified by the set of y and z coordinates.
- **Getting coordinates of common point from front and side view (x, y, z):** Front view gives (x, y) and side view gives (y, z) coordinates and in this sets of coordinates taking point of common coordinate i.e. in both view the y coordinate represent the vertical dimension of image. Due to the vertical dimension of both view are same, therefore both view can be represented in 3D (x, y, z) coordinate having y coordinates as a common point.
- **3D plotting of coordinates (x, y, z):** 3D coordinates taken from previous method now plotted in the three dimensional graph. This three dimensional plot of x, y and z coordinates will show the 3D face model.
- **Smoothing the 3D plot:** After the 3D plotting in the from of coordinates the image must be filtered so that for a given pixel and every neighboring pixel are compared to the 3D original image and the difference between these pixels are used to smoothen the image.
- **3D face model:** Finally it will give the 3D face model.

CONCLUSIONS

This study proposed a 3D face model based on the shape information of human face. This method can be divided into two steps: first step, a number of facial points are found automatically through projection. In the second step, the facial points converts a 3D face model through pixellization and smoothing. Compare with others, this method will not be time consuming and being accurate and complexity of the proposed method is significantly less than that of other methods.

In general, the proposed methods can be improved further. Investigation of alternative fusion techniques and particularly data at an earlier stage, use of more advanced methods of face models techniques are our future research plans. In future we shall implement the above proposed work and of course, the methods will automatically detect the 3D face model in 2D face images within seconds. We hope, further refinement will be our next step.

REFERENCES

Akimoto, T., Y. Suenaga and R.S. Wallace, 1993. Automatic Creation of 3D Facial Models, IEEE Computer Graphics and Applications.

Belhumeur, P.N., J.P. Hespanha and D.J. Kriegman, 1997. Eigenfaces vs. fisher faces Recognition using class specific linear projection. IEEE Trans. Pattern Analysis and Machine Intelligence, 19: 711-720.

Blanz, V. and T. Vetter, 2003. Face recognition based on fitting a 3D morphable model. IEEE Trans. Pattern Analysis and Machine Intelligence, 25: 1063-1074.

Bledsoe, W.W., 1966a. Man-Machine Facial Recognition: Report on a Large-Scale Experiment, Technical Report PRI 22, Panoramic Research, Inc., Palo Alto, California.

Coleman, E.N. and R. Jain, 1982. Obtaining 3-dimensional shape of textured and specular surfaces using four-source photometry. IEEE Computer Graphics and Image Processing, 18: 309-328.

Franc, S., P. Peer, B. Batagelj and S. Juvan, 2002. 2D versus 3D color space face detection-15 seconds of fame-an interactive, computer-vision based art installation, Proceedings of the 7th International Conference on Control, Automation, Robotics and Vision (ICARCV 2002), Singapore, pp: 198-204.

Fua, P. and Y.G. Leclerc, 1996. Taking advantage of image-based and geometry-based constraints to recover 3D surfaces. Computer Vision and Image Understanding, 64: 111-127.

Horace, H.S. and L. Yin, 1996. Constructing a 3D individual head model from two orthogonal views. The Visual Computer, Springer-Verlag, 12: 254-266.

Huang, J., V. Blanz and B. Heisele, 2002. Face recognition with support vector machines and 3D head models. International Workshop on Pattern Recognition with Support Vector Machines (SVM2002), Niagara Falls, Canada, pp: 334-341.

Irfanoglu, M.O., B. Gokberk and L. Akarun, 2004. 3D shape-based face recognition using automatically registered facial surfaces. 17th International Conference on Pattern Recognition (ICPR'04), 4: 183-186.

Kepenekci, B., 2001. Face recognition using gabor wavelet transform. Ph.D Thesis, The Middle East Technical University.

Kurihara, T. and K. Arai, 1991. A transformation method for modeling and animation of the human face from photographs. Computer Animation, Springer-Verlag Tokyo, pp: 45-58.

Lee, Y., D. Terzopoulos and K. Waters, 1996. Realistic modeling for facial animation. In: Computer Graphics (Proc. SIGGRAPH), pp: 55-62.

Magnenat-Thalmann, N. and D. Thalmann, 1987. The direction of Synthetic Actors in the film Rendez-vous à Montrèal. IEEE Comput. Graphics Applic., 7: 9-19.

Magnenat-Thalmann, N., I.S. Pandzic, J.C. Moussaly, Z. Huang and J. Shen, 1995. The Making of Xian Terra-cotta Soldiers, Computer Graphics: Developments in Virtual Environments, (Academic Press) (ISBN 0-12-227741-4).

Moghaddam, B., W. Wahid and A. Pentland, 1998. Bayesian eigenfaces-probabilistic matching for face recognition. In: Proc. IEEE Conference on Automatic Face and Gesture Recognition, pp: 30-35.

Park, U., H. Chen and A.K. Jain, 2005. 3D model-assisted face recognition in video. Proceeding of 2nd Workshop on Face Processing in Video, British Columbia, Canada, May 8-11.

Proesmans, M. and L.V. Gool, 1997. Reading between the lines-a method for extracting dynamic 3D with texture. In: Proceedings of VRST, pp: 95-102.

Romdhani, S., V. Blanz and T. Vetter, 2002. Face identification by fitting a 3D morphable model using linear shape and texture error functions. In: Proc. IEEE Eur. Conf. Comput. Vision, pp: 3-19.

Sun, Y. and L. Yin, 2005. 3D face recognition using two views face modeling and labeling. IEEE CVPR05 Workshop on Advanced 3D Imaging for Safety and Security (A3DISS), San Diego, CA.

Tsalakanidou, F., D. Tzocaras and M. Strintzis, 2003. Use of depth and colour eigenfaces for face recognition. Pattern Recognit. Lett., 24: 1427-1435.

Tsalakanidou, F., S. Malassiotis and M. Strintzis, 2005. Face authentication and authentication using color and depth images. IEEE Trans. Image Process., 14: 152-168.

Williams, L., 1990. Performance-Driven Facial Animation. In: Computer Graphics (Proc. SIGGRAPH), pp: 235-242.