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Feature Extraction using various Pose Angles in Three Dimensional Face Recognition

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Abstract

Feature extraction is an important phase in the part of three dimensional face identification. It converts the segmented item to depiction that tells about main characteristics and elements. It begins with the first step to compute details, form features and interconnected to dimensionality reduction. Before gain the features variety of image preprocessing methods like image resize, thresholding, normalization, rendering etc., are applied to test picture, after the feature extractions are claimed to get features that will be helpful in categorizing and identifying the pictures. Image processing has multiple feature extraction methods like biometric identification, Character identification etc.. In this paper, we described automatic three dimensional face identification using feature extraction with multiple pose changes by using Michigan State University(MSU) and University of Notre Dame(UND) database. Nose tip and mouth corner points are used to identify the three dimensional face. To identify the nose tip, Instructional maximum method is used. In this paper, Feature extraction techniques using various pose angels in three dimensional face identification is discussed.

Keywords: Three dimensional face identification, Feature extraction, Instructional maximum.

INTRODUCTION

Feature extraction tells the related shape news contained in a design so that the task of categorizing the model is formed easily by a formal manner. The dimensionality reduction is the most important form of design recognition and image processing. The greatest part of feature extraction is to get the related information from the initial data and describe that information in a lower dimensionality space. Altering the input condition into the collection of features is called feature extraction.

If the extracted features are cautiously taken and it is anticipated that the features collection will extract the related news from the input condition in order to carry out the desired work treating this smaller representation in place of the full-size input design recognition is an important scientific inquiry in the part of image processing.

It has been applied in more operations like Contour method, Gabor features and Fourier descriptors. In the recent 62's these feature extractions were yet very costly, so it's only handled by big societies and government actions[21,24]. Now a day's model recognition techniques are less cost. Multiple scientific inquiries have been performed to develop newer techniques and procedures that would make smaller processing time and precision.

As an example, face recognition is the process of changing scanned pictures of machine printed into the computer processable structure. Face recognition can be divided into two groups: i) Identification ii) Verification. In a Verification process, the news of a single person, who claims certain affinity, is compared to recorded individual claims. The consequence gives whether the identity claims shall be received or neglected. The beginning human face news to verify the certain single person information, it is called as Identification.

Face recognition can be classified into four important steps. First thing is, a human stands in front of the face recognition system, commonly between one to two feet onward the broad angle camera counts the situation of their face. A full image of the face can be taken by the second camera using zooming method. After the face focus, it covers a circular grid on the picture of the face and it is used to find the bright and dim areas. The main intention of overlying the grid is to produce 'points' within the model. The recorded picture is verified against a stored image, nearly two seconds only to recognize the face system.

RELATED WORK

A better general view on three dimensional face identification can be invented by K.W. Bowyer, K. Chang, P. Flynn. Author[1] described a view of recognition technique in the Three Dimensional face and it gives good performance than two Dimensional. The given conditions of the Three Dimensional face give much different news and low sensitive to changes in

surrounding situations. Jennifer Huang, V.B., Bernd Heisele described multiple techniques to identify the Three Dimensional face. In the various methods, they used morphable three Dimensional head model. The technique is implemented to do various illuminants[2,3]. Ansari and Abdel-Mottaleb proposed a technique (ie) stereo designs landmark dots on all sides like eyes, nose, and mouth[4].

In 2001, J. Ahlberg applied CANDIDE-3 method for face identification. To get a 3D design, alter the CANDIDE-3 face to equate the prominent mark dots[5]. The main intention of this technique is, the 3D design does not support by others. Authors[11,7,12.13]described that initially to identify the face skin color segmentation techniques are used. This may be accepted by X and Y direction angles of edge designs.

Authors[14,15,16,17,18,19]described feature localization technique that this method considered i) Appearance ii) Geometric iii) Structure based techniques. Appearance-based technique follows Principal Components Analysis, Independent Components Analysis, Gabor wavelets. To identify the distance between the fiducial points, Geometric based techniques is used. The structure-based techniques are used to fit human prominent mark.

Author[6] proposed that the 3D data is used to get dangerous details like sensor pattern, spikes. The information of the three dimensional image can be a very high dimension. Author[23] proposed that most commonly feature extraction is applied to identify the three dimensional face. Recently feature extraction techniques are very difficult to choose manually.

Author[8,9,10] proposed that mostly Iterative Closest Point technique is used to recognize the three dimensional face. This technique is used to remove face expressions and pose changes; the main drawback of the technique is very costly. Author[9] described the same ICP technique with time consideration to recognize the three dimensional face but it's not applicable for real-time uses.

In this paper, we proposed feature extracting portions and calculating the head pose from huge pose changes. To correct the face, extracted features are applicable. Three face identification is implemented by effective feature extraction technique.

PROPOSED DESIGN

Feature Extraction

The whole feature extraction function is shown in Figure 3. The scanned image gives 4 matrix values like X(r, c), Y(r, c), Z(r, c), and M(r, c), here X, Y and Z are spatial and intensity coordinates, these values are declared in millimetres. Here M-> mask, it is used to mention the values valid or not. M(r, c) = 1.....p(r, c) = valid else zero.

Face Segmentation

In face identification, the initial process is to extract the face part from the main image. The unwanted portions like spatial coordinates are removed by M. The face part is divided by X and Y directions of M. The output of a segmented image from the scanned image is given below in Figure1.

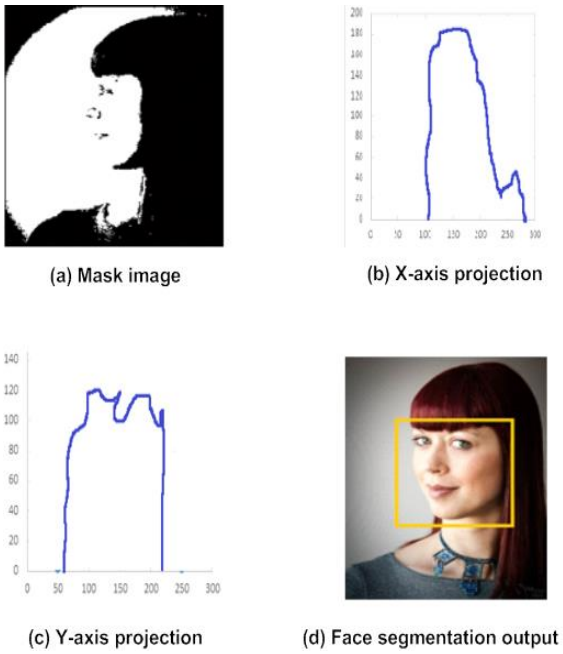

Figure 1: Segmented Image

Calculation of Pose and Nose Tip

The main part of a human face is a nose. The posture face is rotated from a frontal face. In a frontal face, the nose tip commonly has highest Z price. If rotate, the pose of a face with beginning coordinates the Z value of nose tip is high as shown in Figure 2. The nose tip has the highest depth when the pose of a face rotate in any direction, so we determine the nose tip value and pose angle parallelly. The described technique gives various angles to change the pose face from side to side.

Figure 2: Instructional maximum of the nose tip

The major five process are given below, to calculate the pose and nose tip.

a) Pose quantization

b) Instructional maximum

c) Pose amendment

d) Nose extraction

e) Nose identification

In pose quantization, the X – Z plane side to side angle varies begin -90 to 90 degrees. The R_{pose} is quantized into N_{pose} with same angle distance. The instructional maximum is used to search the highest projection in various pose angles. The original (x, y, z) face landmark is moved to new (x^i, y^i, z^i) part. The new pose angle matrix (I) format is given below:

$$\begin{pmatrix} x^i \\ y^i \\ z^i \end{pmatrix} = \begin{pmatrix} \text{Cos i} & 0 & \text{sin i} \\ 0 & 1 & 0 \\ \text{-sin i} & 0 & \text{cos i} \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix}$$

Where $z^i(a) = \max(z^i, i = 1, 2, \ldots\ldots, N)$ is applicable for nose tip person with respect to pose angle. Continuously check the pose angle to get the 'M' values. In some case, the instructional Maxima have similar face landmarks 'p' with respect to multiple pose changes.

Sometimes highest projection value is taken as a pose angle. The pose amendment image gives (p,θ). The initial landmarks (x, y, z) are moved to (x', y', z'). At the point of 'p', we can extract the nose portions. The rotated face point pose angle θ is given below:

$$\begin{pmatrix} x^i \\ y^i \\ z^i \end{pmatrix} = \begin{pmatrix} \text{Cos i} & 0 & \text{sin i} \\ 0 & 1 & 0 \\ \text{-sin i} & 0 & \text{cos i} \end{pmatrix} \begin{pmatrix} x' \\ y' \\ z' \end{pmatrix}$$

Take X'(r, c), Y'(r, c), and Z'(r, c) as new pose amendment matrix. Search the nearest landmark to the Y – Z plane. Resampling method is used to linear interpolation. To recognize the nose tip from the human (p,θ), check the nose profile from subspace separation. Distance from Feature Space technique is used to measure the distance of nose tip. It is shown in Figure 3.

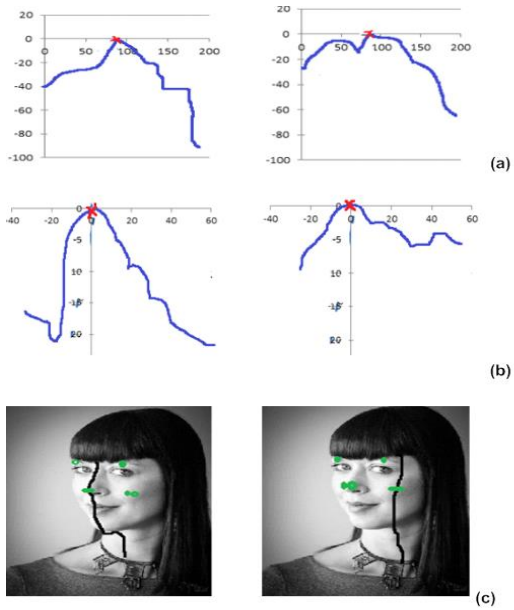

Figure3:(a) Extracted nose profiles (b) Resampled nose profile (c) Extracted profiles overlaid on the original scan

Eye and Mouth Extraction

Mouth and eye portions are identified by fiducial points, it gives accuracy and efficiency. In our trial, 135 frontal face images are handled to calculate the design. The calculated nose tip and pose values are overlaps on the original image. Shape index is used to resolve the eye and mouth corners.

Face Identification

All face identification technique are used to check original three dimensional face to scanned face image with various pose alterations. The nose tip is used to extract the three dimensional face part. We can extract the three dimensional face like front face and side face. Initially, the described technique finds the midpoint of a face. The front face mid mark is placed on the described image. The original three dimensional face image fiducial points are assumed. After this assumption, the scanned image fiducial points are compared to original three dimensional face points with various pose changes.

To identify the side face, initially, a side outline of a three dimensional face will be discovered. A direct mark of the nose of the given face is taken as one base mark. Second, a direct mark is perpendicular to the initial base mark and tangent with an outline of a nose. The space between the dot, which is division point of the initial baseline and 2nd baseline, also mark, which is the division point of 2nd base mark and the outline of up mouth, which is taken as a reference point for the side face. This division point is applied to discover a greater base mark for a front face. A nose tip reference marks can be discovered by base mark and tangent with the nose outline. These reference points differentiate the original and the scanned image as shown in Figure 4.

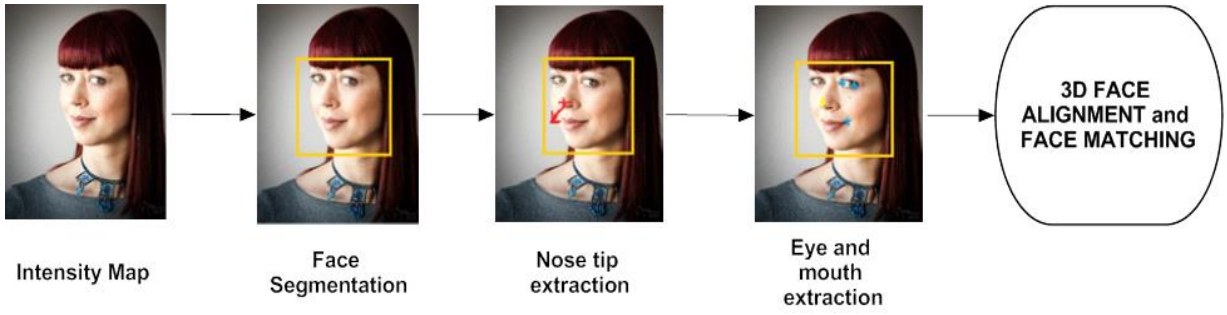

Figure 4: Three dimensional face matching using feature extraction

RESULT AND DISCUSSION

In our experiment, we used MSU and UND database. MSU gathered the data for multiple pose changes as in Figure 5. UND gathered the data for frontal face image[22] as shown in Figure 6. Minolta VIVID scanners are used to gather the MSU and UND database. The captured pose angle values are less than -44 and more than 44 degrees. Our feature extractor accurately placed the nose tip part in 97% of the experiment. The MSU data consists of 300 multiple trial scans. The UND data consists of 951 three dimensional images.

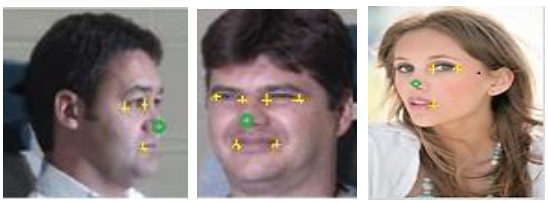

Figure 5: Feature extraction outputs on the MSU database

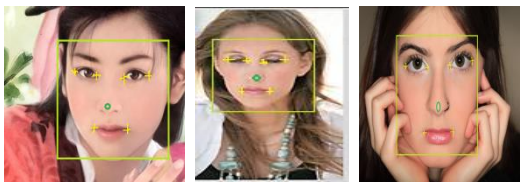

Figure 6: Feature extraction outputs on the UND database

Table 1 gives the systematic representation of the MSU and UND database. If the frontal image is given, a most exact algorithm can be planned[20]. The initial scanned image can be taken as a template and the other scans are handled for queries. However, faces are broadly impartial, some images have grinning appearance. Most of the face images have the same background. There is 675 query image and 276 templates are present. Normalized space technique is used to calculate the performance of feature. In MSU database, template and query image is 2.5D scan model.

Table 1: Systematic representation of MSU and UND database

Features	MSU database			UND database		
	Mean (mm)	Std (mm)	Median (mm)	Mean (mm)	Std (mm)	Median (mm)
NT	6.3	13.3	4.2	8.2	19.3	5.2
LE	7.0	9.1	5.2	8.1	17.1	5.7
LE	8.9	13.0	5.9	8.2	17.1	5.3
ORE	13.5	11.8	12.6	9.4	17.0	5.4
OLE	13.2	10.0	11.6	10.2	18.0	7.3
RM	6.6	12.8	3.7	5.9	16.8	2.8
LM	5.1	8.9	3.1	6.1	17.8	3.2

NT – nose tip; OLE – outside left eye corner

LE – inner left eye corner; RM – right mouth corner;

RE – inner right eye corner; LM – left mouth corner;

ORE – outside right eye corner;

CONCLUSION

In this paper, we described a feature extraction technique with multiple pose variations for three dimensional face identification. With the calculated pose, the system neglects the invalid reference points. The extracted features are handled to align the face images. As an output, three dimensional face identification has been promoted. Our system performs a recognition with a very high precision compared to manually calculated points. The possible extensions to this model include a neglect choice to form the system.

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