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Nose Tip Detection Using Gradient Weighting Filter Smoothing

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Abstract:- In the area of face recognition systems, features especially nose tip has less significant attention for smoothing. This proposed model is based on the process of smoothing of 3D face images with feature detection like nose tip. Our proposed method uses Gradient Weighting Filter technique for smoothing with particular points' neighborhood surrounding in 3D face and replaces that with the weighted value of surrounding points in 3D face images. We will use the gradient weighting algorithm for detecting the nose tip and this method will correctly detect the nose tip in any position along with X, Y and Z axes. All the experiments will be performed on GAVAB, a 3D face database.

Keywords:- Nose tip, Gradient Weighting Filter, 3D Face images, Smoothing, Noise

I. INTRODUCTION

Eyes and Nose are the most important features on human faces. The detection of eyes and the nose tip had been a vital step in many face-related applications. The surface of a 3D model reconstructed from real world data is often corrupted by noise. An important problem is to suppress noise while preserving the geometric features of the model. The technique of image smoothing is used to remove the noise in digital images. It is a classical matter in digital image processing to smooth image. And it has been widely used in many fields, such as image display, image transmission and image analysis, etc. Image smoothing has been a basic module in almost all the image processing software. It is a method of improving the quality of images. Its main purpose is to be fit for the man's physiological vision system. The objects processed are images corrupted with different factors during the course of their generation, transmission, process and display, etc.

There are many factors that can cause the existence of noise. Different factors can cause different kinds of noise. In practice, an image usually contains some different types of noise. So good image smoothing algorithm should be able to deal with different types of noise. However, image smoothing often causes blur and offsets of the edges. While the edge information is much important for image analysis and interpretation. So, it should be considered to keep the precision of edge's position in image smoothing.

The main idea of our approach consists of applying gradient weighting filter to points on area where the noise is present and then applying a feature detection algorithm i.e. locating the nose tip on a 3D face in any orientation. The gradient-dependent weighting filters are mainly based on the following principle: in a discrete image, the difference of the gray values on pixels in outer area is larger than that in inner area. In same area, the change on centre pixels is smaller than that on edge pixels. The gray gradient is direct ratio to the gray difference in vicinity. That is, where the gray change is slower, the gradient is smaller. A function whose value reduces with the increase of the gradient is adopted, and it is chosen as the weight of the window. So, the smoothing contribution is mainly coming from the same area. Accordingly the edge and the detail cannot be lost apparently after image smoothing.

II. PROPOSED WORK

Firstly the image is read from GAVAB, a 3D face database. Next some pre-processing methods are applied to eliminate unwanted details such as facial hair, scars etc. After the necessary features are located, the orientation of models is done using translation and rotation process. The model of the proposed system is as follows:

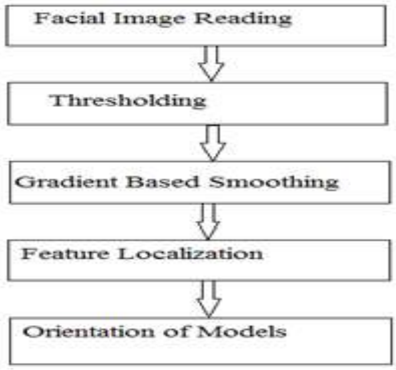

Fig. 1 Model of the proposed system

A. Facial Image Reading

Our technique will use GAVAB face database. It contains 249 images of facial surfaces. A range image is simply an image with depth information as shown in Fig. 2. In other words, a range image is an array of numbers where the numbers quantify the distances from the focal plane of the sensor to the surfaces of objects within the field of view along rays emanating from a regularly spaced grid. For example, a nose tip is the closest point to the camera on a face, so it has the highest numerical value.

Range images have some advantages over 2D intensity images and 3D mesh images. First, range images are robust to the change of illumination and color because the value on each point represents the depth value which does not depends on illumination or color. The 3D information in 3D mesh images is useful in face recognition, but it is difficult to handle. Different from 3D mesh images, it is easy to utilize the 3D information of range images because the 3D information of each point is explicit on a regularly spaced grid. Due to these advantages, range images are very promising in face recognition.

Fig. 2 Range image samples from the database

B. Thresholding

Otsu's method is an adaptive thresholding technique that will be applied here. It is used to automatically perform the reduction of a gray level image to a binary image. The algorithm assumes that the image to be thresholded contains two classes of pixels (eg. Foreground and Background) then calculates the optimum threshold separating those two classes so that their combined spread (intra class variance) is minimal.

C. Gradient Based Smoothing

In designing gradient-selected filters, power and exponential function are often chosen as weighting function. Especially when the power is equal to –1, the filtering is called gradient reciprocal weighting filtering. When the function is the exponential one, the filtering is called adaptive filtering. When we extract lines from remote sensing images, the adaptive filtering is often adopted in pre－processing to realize the aim of noise removal and edge enhancement. It can be described as:

$$f(x) = e^{-x^2/2k^2}$$

Where, x is the gradient, k is the parameter that determines the smoothing degree. By analysis, we find that k can be used to adjust the degree of sharp of the exponential function. If k is bigger, the exponential function will be slower in change. So, if the gradient is bigger than k, the gradient will increase with the adding of the iterative times, so as to realize the aim of sharping edge. Oppositely, if the gradient is smaller than k, the details will be smoothed. Thus, the value of k is critical to the smoothing effect. But, there are not so many quantitative analysis of k in the description of adaptive filter. Considering the above factor, the selection of k and its influence to the gradient weighting filtering can be described as follows:

- Modify the gradient intensity image. That is, adding a negative value to the gradient intensity on each pixel, so as the mean gradient intensity is equal to zero.
- Calculate the square errors of the new image: σ2=E(x－Ex)2=Ex2. Where, Ex is the mean gray gradient, x is the gradient intensity on the corresponding pixel.
- Assume k=σ, the exponential function will be the standard normal distribution. Adopting this value as the parameter, we can remove noise and preserve detail simultaneously.

D. Feature Localization

It is one of the most important tasks of any facial classification system. Compared to other facial landmarks, nose offers few advantages. Due to the distinct shape and symmetrical property of a nose, it is frequently used as a key feature point in 3D faces representation. For example, finding nose facilitates the search for other landmarks such as eyes and mouth corners in order to employ robust facial feature extraction. Unlike nose, other features can change significantly due to facial expression, e.g., closed eyes and open mouth. In addition, the characteristics of the nose which indicates the center of the face and always pointing frontal are found useful for head pose estimation and face registration. Also the nose tip is the closest point to the camera which gives the highest intensity value. For the nose tip localization we will use maximum intensity algorithm as the tool for the selection process.

E. Orientation of Models

The images are classified as frontal face images and non frontal face images so that non frontal noses are rotated about x axis. After feature localization based on the extracted feature we will align the extracted face model. The features are then used for orientation.

III. CONCLUSIONS

The proposed noise smoothing scheme is based on an observation that the variations of gray levels inside a region are smaller than those between outer regions which ultimately improves the performance. It also preserves the details and edges of images effectively as compared to other filtering methods.

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