Report on face reconstruction from a single image

I. Overall framework

Frames in red have been implemented.

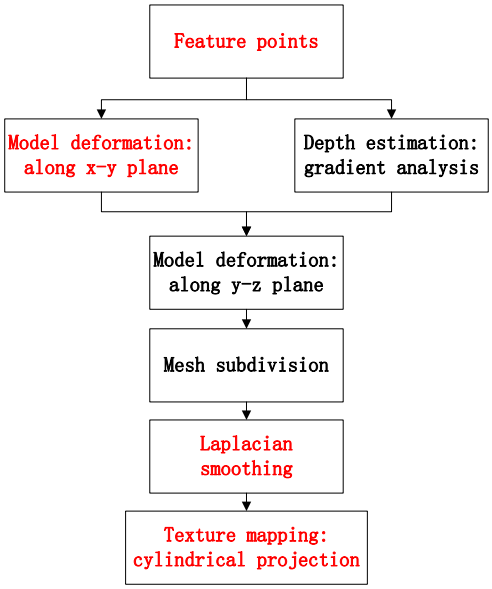
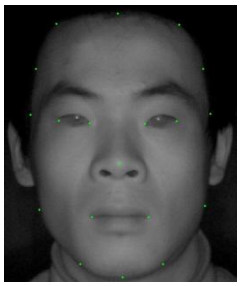


Fig. 1

II. Automatic facial features detection



Total points:	**19**
Outline:	12
Left eye:	2
Right eye:	2
Nose:	1
Mouth:	2

Fig. 2

III. Model deformation

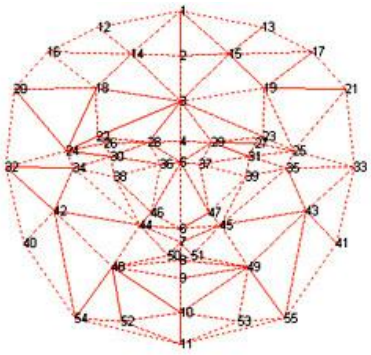


Fig. 3 Generic face model (55 points & 94 faces)

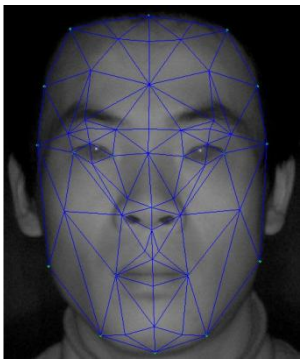


Fig. 4 Radial basis function based deformation

IV. Laplacian smoothing

Smooth out sharp points and lines.

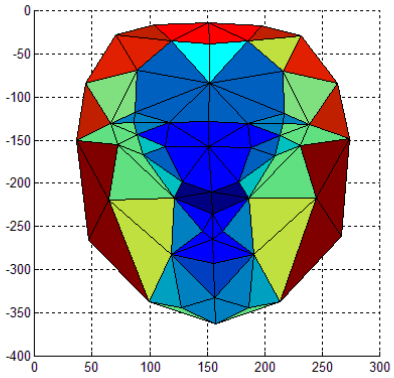


Fig. 5 Smoothed front face mesh

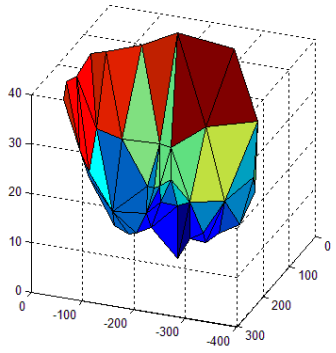
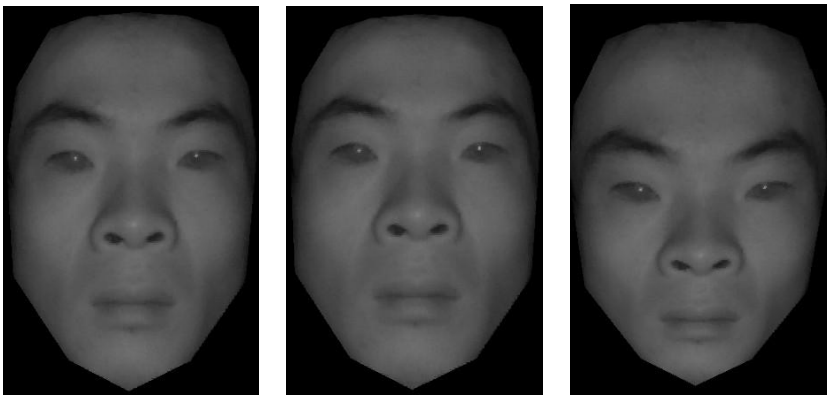


Fig. 6 Different view

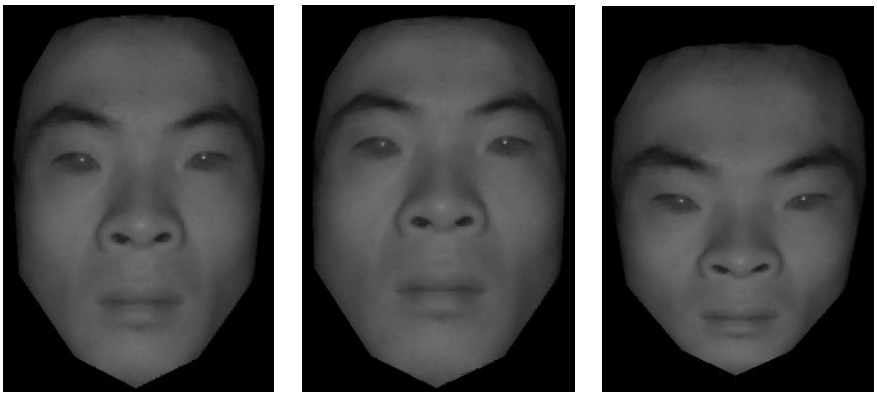
V. Texture mapping

Fig. 7 Synthesize texture by cylindrical projection of deformed 3D face mesh



(a) frontal (b) rotate up (c) rotate down

Fig. 8 Reconstructed face: rotate along model center

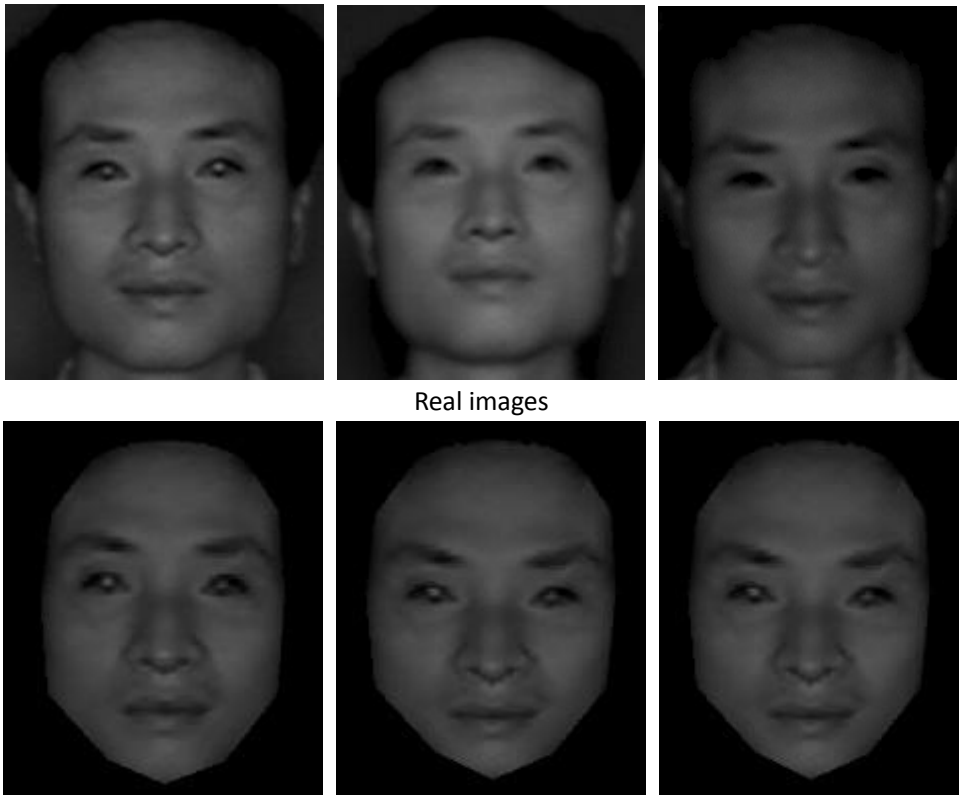


(a) frontal (b) rotate up (c) rotate down

Fig. 9 Reconstructed face: rotate along center of two eyes

VI. Comparisons: Real vs. Synthesis

1. Test case 1



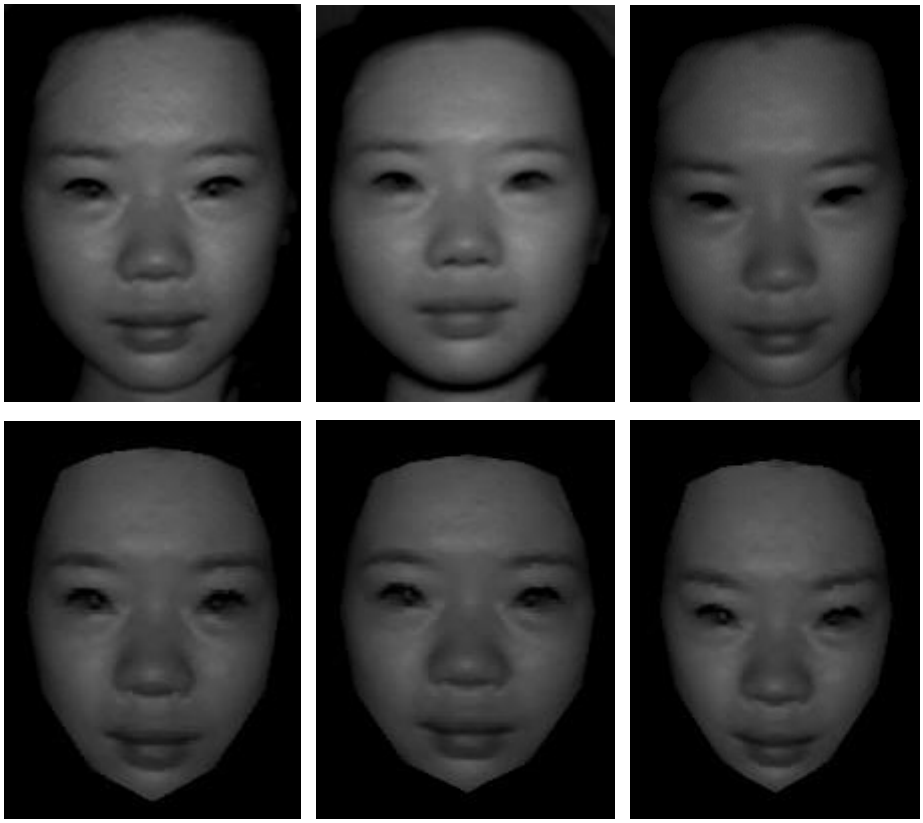
Real images

Synthesized Images

Frontal Rotated Up Rotated Down

Figure 1. Test Case 1

2. Test case 2



Frontal Rotated Up Rotated Down

Figure 2. Test Case 2

3. Test case 3

Frontal Rotated Up Rotated Down

Figure 3. Test Case 3

VII. Conclusion and Next work

1. Synthesized images of different poses are alike real images of similar poses to some extent.
2. However, because the depth information was not well extracted, this method my not apply to large pose variations. So next work is centered on depth extraction from intensity image. An applicable method is to directly integrate surface gradients obtained by Lambertian model
3. To realistic shape recovery, coarse face mesh should be refined by mesh subdivision, such as butterfly interpolation.
4. Face contours should be well extracted to realistically synthesize face images and as geometric features for face recognition.

VIII. Future plan

1. Based on the reconstructed 3D face, perform face pose estimation using methods such as linear regression.
2. Transfer this “estimation-by-reconstruction” method to natural feature tracking in outdoor environments, for human face is a relatively complex natural object.

IX. References

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