EE7374 Project

-----image morphing program

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Abstract

Image morphing program is based on a algorithm that can extract feature points on the object ,and warp one set of point to another ,then composite the results of the warping.

Introduction

Image morphing applications are everywhere , especially in movies , videos ,ads and photograph .Morphing is an image processing technique used as an animation tool from one image to another.The basic idea is to specify a warp that distorts first image into second one .And what make it so cool is the inverse will distort the second image into the first.

In this project , we build up a algorithm that can achieve the automatic morphing based on the important feature points.

Normalization

For a pair of images ,we will normalize these two to a same and reasonable size at first .Take the human face for instance shown below:

Fig.1

We will normalize the image A to A' which matches the image B .

As a step of preparation ,normalization is very import ,and save much time for us .

Feature points

Since we are focused on the actual morphing , We manually select the feature

points. For the given images, we select the same number of points in the same order for each image in pair. These points are exactly what we want to warp on. Let's take the human face for instance.

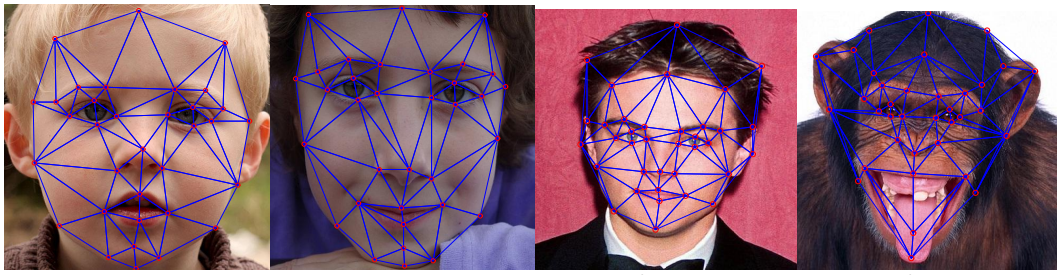

Fig.2 Fig.3 Fig.4 Fig.5

For the images shown above , we basically select the all the important points like the eyes,mouths,noses and also the edge of hair .These points must be selected in the same order with very similar feature , or warping will fail which is the next thing we are going to do.

And also , We use Delaunay triangulation to divide image into separate triangular which is correspond to the other one in pair of images .

Warp

The warp transformation is based on the selected points. The purpose is to match the feature points to the objective's .There are many different methods to achieve this .

Basically, we can consider these feature points is connected as triangular .each pair of the corresponding triangular defines a mapping in coordinate, Then we need to match the points in each triangular to the corresponding ones, which is shown below:

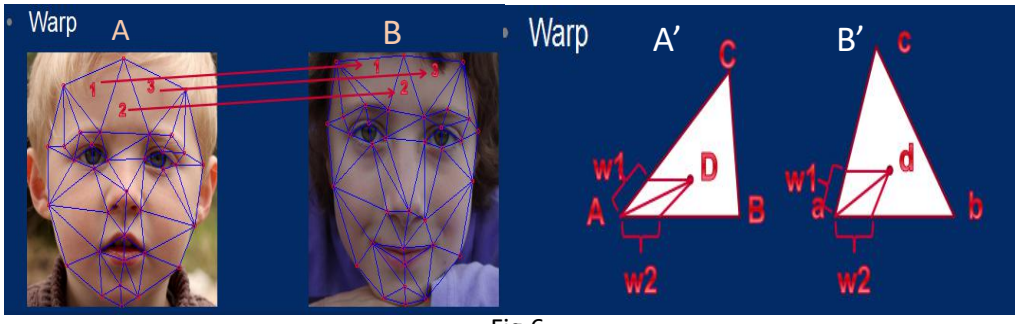

Fig.6

In Fig.5 , Firstly we have known the image A and image B .Then we will use the linear equation(1) to warp :

$$C = \alpha A + (1-\alpha)B \qquad for \qquad 0 \le \alpha \le 1 \tag{1}$$

Secondly ,we warp the image A to image B this time ,so the $\alpha = 0$ .Then we want to warp pairs of arbitrary corresponding points like D and d in each triangular like A' and B'. To achieve it , we will compute the weight which will help us get any corresponding points in triangular：

$$\mathrm{w1} \times \mathrm{AC} + \mathrm{w2} \times \mathrm{AB} = \mathrm{AD} \tag{3}$$

$$\mathrm{w1} \times \mathrm{ac} + \mathrm{w2} \times \mathrm{ab} = \mathrm{ad} \tag{4}$$

$$w1 = \frac{\left[\left(C_y - A_y\right)\times\left(D_x - A_x\right) - \left(C_x - A_x\right)*\left(D_y - A_y\right)\right]}{\left[\left(C_y - A_y\right)\times\left(B_x - A_x\right) - \left(B_y - A_y\right)*\left(C_x - A_x\right)\right]} \quad (5)$$

$$w2 = \frac{\left[\left(B_x - A_x\right)\times\left(D_y - A_y\right) - \left(D_x - A_x\right)*\left(B_y - A_y\right)\right]}{\left[\left(C_y - A_y\right)\times\left(B_x - A_x\right) - \left(B_y - A_y\right)*\left(C_x - A_x\right)\right]} \quad (6)$$

Then we will iterate all the triangulars randomly and warp all the points in triangulars to the other corresponding points .


Fig.7


Fig.8


Fig.9

As the pictures shown above, we warp the Fig.7 and Fig.9 according to the feature points,and $\alpha = 0.5$,then we get the Fig.8 . The face in Fig.8 has been warped and the The outline of the facial features looks like the one in Fig.9

Compositing

After warping ,we will composite these two images to complete the morphing .We use linear Cross-dissolve method which is the most popular one .

In general ,linear cross-dissolve reduces variation ,smoothing the image by reducing the sharpness and also reducing contrast.The fundamental equation of cross-dissolve is :

$$C = \alpha A + (1-\alpha)B \qquad for \qquad 0 \le \alpha \le 1 \quad (4)$$

C is created by merging the image A with the second image B according to their relative opacity α . Linear interpolation outputs a convex linear combination of its inputs ,a weighted sum where the weights are positive and sum to one .For out project, the opacity α will change from 0 to 1 throughout the process. When $\alpha = 0$,that means we are showing the pixels from image B .When $\alpha = 1$,that means we are showing the pixels from image A .

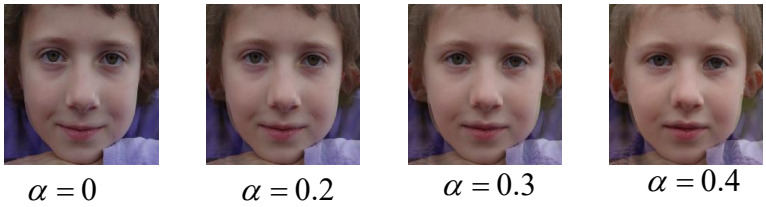

Fig.10

As it is shown in Fig.6 above , the result cross-dissolve is good and we can clearly see the changes between $0 \le \alpha \le 1$

Improvement in the next days

We are trying to implement a feature detection system to automatically select the points and a automatically normalization method.

For images compositing, we will composite the results of three methods which are color preserving method , contrast preserving method and salience preserving method. Which is been studied in the paper named of Cross Dissolve Without Cross Fade: Preserving Contrast,Color and Salience in Image Compositing.

References

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