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BLG 453E – Computer Vision: Homework 2

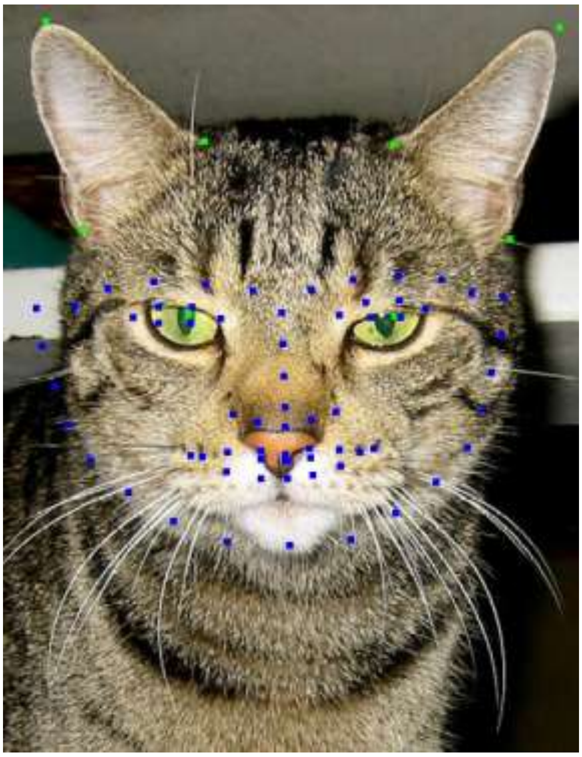
Part1:

In this part we have obtained features/landmark points for humanface images by using dlib and "shape_predictor_68_face_landmarks.dat" model. And obtained landmark points for cat images by reading the prepared files in format of ".cat". Before doing that, we have resized the images to the same size. This is worked well for humanface image since, we obtained it's features by using model. On the other hand, this "Resize" operation resulted as a contradiction between Resized cat image and pre-determined landmarks which stored in ".cat" file. In order to solve this we resized those points as well.

RESULT IMAGES:

Part2:

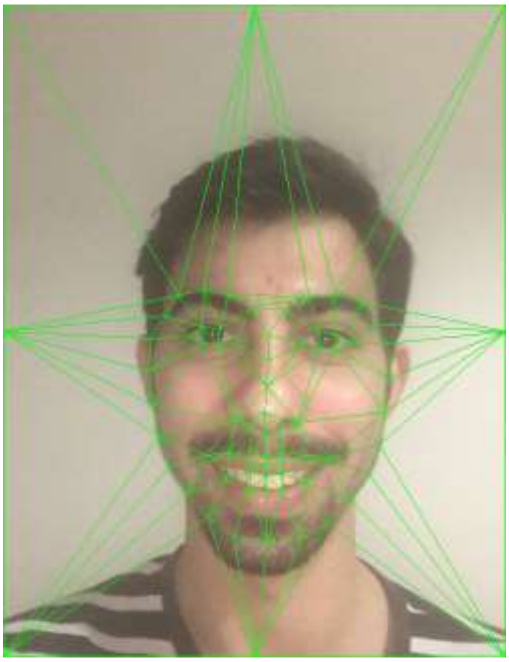
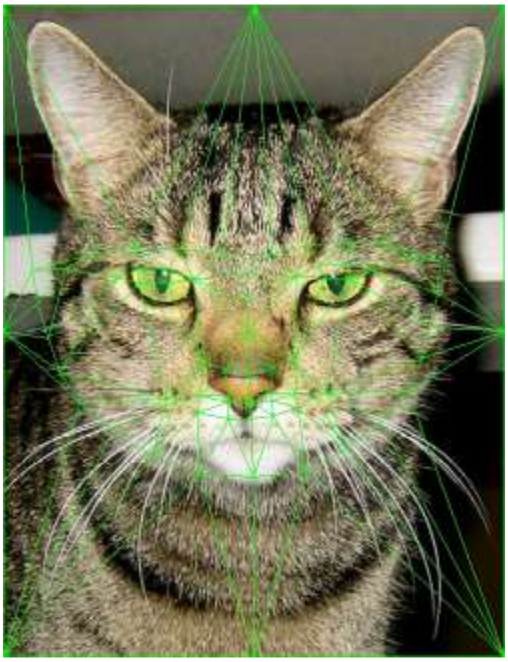
In this part we placed "template points" to the face of cat. While doing this, we used landmark points which we obtained in the part1. In order to place template point to the cat's face, those points must have been scaled vertically and horizontally and shifted. Horizontal scale ratio is obtained by the proportion of gaps between eyes of cat and gaps between eyes of template. Vertical scale ratio is obtained by the proportion of gaps between midpoint of eyes and the mouth point of cat and template. After performing the scale operation, we shifted scaled template points as **displacement vector** between cat mouth point and 66th(mouth point) template point.



Part3:

In this part we have drawn delaunay triangulation for cat image and human face image by the help of skeleton code given. . In order to accomplish that we pushed obtained landmark points and 8 points from the edges of the images, to the **subdiv** class then get delaunay triangles. We obtained different numbers of triangles for human face image and cat image but this is not a problem for this part. I will mention my solution to that problem in part5 section.

RESULT IMAGES:

Part4:

In this part we draw a triangle on a canvas and **Transform** it to a target triangle by using a **Affine Transform Matrix**. In order to that we have calculated the affine transform matrix, then interpolate this Transform over time. Since this operation is a linear operation it obeys the superposition rule and can be used with multiplication and addition operations.

$$\begin{bmatrix} x'_1 \\ y'_1 \\ x'_2 \\ y'_2 \\ x'_3 \\ y'_3 \end{bmatrix} = \begin{bmatrix} x_1 & y_1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & x_1 & y_1 & 1 \\ x_2 & y_2 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & x_2 & y_2 & 1 \\ x_3 & y_3 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & x_3 & y_3 & 1 \end{bmatrix} \begin{bmatrix} a_{11} \\ a_{12} \\ a_{13} \\ a_{21} \\ a_{22} \\ a_{23} \end{bmatrix}$$

$$a = M^{-1}q$$

I used this formula to calculate Affine Transform.

Link: https://www.dropbox.com/s/o30yj67bvkif3rz/part4.mp4?dl=0

Part5:

In this part we performed a image morph operation between Human face image and cat image. We basically apply part4 to the all triangle pairs for both human image to the **intermadiate image** and cat image to the intermadiate image for given **t** value which is in the [0, 1] interval.

But before doing that we must pair the triangles in both images. In order to accomplish that, first i have tried to construct triangles for both images then pair them, yet this yield another problems, like contradiction in numbers of triangles and neccessity of a efficient and successful pairing algortihm. I have paired them compare to distances between triangle centers. Even though it performed well for first triangles, later on performed poorly for last triangles. Thus, i have abandoned this method, and constructed triangles of the second image based on the triangles of the first image. This solved both pairing and overcomed contradiction in numbers of triangles.

After the triangle matching operation, i have calculated the intermediate triangles and apply backward map from intermediate triangles to the images then resample(Bilinear interpolation) them, to get intensity values.

Link: https://www.dropbox.com/s/9e3ywaa6olkh1x6/part5.mp4?dl=0