Programming Assignment 2

CS 485  
Shubham Gogna  
Due: March 3, 2015  
Dr. Mircea Nicolescu

Part One: Affine Transformation on Faces

In order to do the affine transformations, the equations provided in the assignment text needed to be converted for use with four features. The result was the following equations:

All other variables remained the same. Using the provided SVD code, this system of overdetermined equations was solved for each of the images used for input. The resulting values for the parameters was then used to iterate through the input image and map the pixels into the destination image (a smaller window). The image was initially set to all zeros and all out of bound mappings were ignored. If two pixels in the source image mapped to the same point in the smaller image, the average of the intensities was used. Below are the results for each of the images.

|  |  |  |
| --- | --- | --- |
| Original | Normalized | Information |
| From S1, Picture 1 | Normalized S1\_1 | [ 0.621986 0.0224843]  [ 0.020369 0.76006 ]  [ -9.24726 -28.9644 ] |
| From S1, Picture 2 | Normalized S1\_2 | [ 0.480361 0.0256539 ]  [ -0.0755949 0.679996 ]  [ -3.13267 -20.672 ] |
| From S1, Picture 3 | Normalized S1\_3 | [ 0.604052 0.0518877 ]  [ -0.0145673 0.657755 ]  [ -5.75224 -22.7875 ] |
| From S1, Picture 4 | Normalized S1\_4 | [ 0.52057 0.0514115 ]  [ 0.0909466 0.737517 ]  [ -2.68097 -23.0382 ] |
| From S1, Picture 5 | Normalized S1\_5 | [ 0.514801 0.0546319 ]  [ -0.132923 0.699005 ]  [ -3.1711 -22.5429 ] |
| From S1, Picture 6 | Normalized S1\_6 | [ 0.550073 0.0398044 ]  [ 0.0775932 0.725349 ]  [ -1.85912 -23.8576 ] |
| From S1, Picture 7 | Normalized S1\_7 | [ 0.590095 0.0431623 ]  [ 0.00621204 0.814563 ]  [ -5.82753 -26.618 ] |
| From S1, Picture 8 | Normalized S1\_8 | [ 0.618903 0.0625453 ]  [ -0.0151204 0.718721 ]  [ -8.74824 -24.4848 ] |
| From S1, Picture 9 | Normalized S1\_9 | [ 0.616317 0.0609027 ]  [ -0.0461512 0.772676 ]  [ -9.00469 -18.8988 ] |
| From S1, Picture 10 | Normalized S1\_10 | [ 0.556532 0.0462219 ]  [ -0.0939164 0.691027 ]  [ -6.12081 -27.5454 ] |
| From S2, Picture 1 | Normalized S2\_1 | [ 0.65333 -0.0482479 ]  [ 0.0629359 0.812993 ]  [ -10.785 -29.4372 ] |
| From S2, Picture 2 | Normalized S2\_2 | [ 0.695013 -0.0123148 ]  [ -0.01847 0.804535 ]  [ -15.5699 -28.9903 ] |
| From S2, Picture 3 | Normalized S2\_3 | [ 0.62275 -0.0842586 ]  [ 0.111101 0.814512 ]  [ -9.4403 -27.684 ] |
| From S2, Picture 4 | Normalized S2\_4 | [ 0.695971 0.0311358 ]  [ 0.00175023 0.804551 ]  [ -14.4672 -32.9737 ] |
| From S2, Picture 5 | Normalized S2\_5 | [ 0.668366 0.0421575 ]  [ -0.0295627 0.801745 ]  [ -16.7521 -33.4879 ] |
| From S2, Picture 6 | Normalized S2\_6 | [ 0.636364 -0.0615507 ]  [ 0.131246 0.770884 ]  [ -7.329 -26.6717 ] |
| From S2, Picture 7 | Normalized S2\_7 | [ 0.717603 -0.0233863 ]  [ 0.0349139 0.82758 ]  [ -14.6408 -31.7031 ] |
| From S2, Picture 8 | Normalized S2\_8 | [ 0.631866 -0.0348289 ]  [ 0.0878936 0.777597 ]  [ -9.21027 -26.8388 ] |
| From S2, Picture 9 | Normalized S2\_9 | [ 0.674624 -0.0182642 ]  [ 0.0511041 0.803091 ]  [ -17.7041 -31.0324 ] |
| From S2, Picture 10 | Normalized S2\_10 | [ 0.675138 0.0733095 ]  [ -0.113516 0.815083 ]  [ -17.093 -36.5321 ] |

Ideal Pixel Positions for the four features:

For the most part, the normalized images were close to their ideal positions. In cases where the subject is looking straight at the camera, the transformation does a really job at mapping the features in the result image. In cases where the subject is looking to their right or left, the transformation stretches the face to bring the features in alignment with the ideal. This is the expected result because the ideal position assumes a forward facing subject.

For example, we can see that S2\_10 has the subject facing to the right. The resulting normalized image has a gap on unmapped pixels on the right because of the facing, but the features are still brought close to their ideal location. In contrast, S2\_2 has the subject facing forward (but slightly facing the right) and the resulting normalized image is able to map from the source to all the pixels in the destination (no dark gaps).

It should also be noted that a large amount of variation from the ideal mouth position occurs with the subjects facing away from the camera. The eyes are fairly consistent and within 1-5 pixels of the ideal. The nose tip is up to 7 pixels away from the ideal. The variation in the mouth is much larger and it can be seen very clearly in S1\_5, S1\_10, and S2\_10 which exhibit the properties that cause the large mouth error distance.