CMSC733: Computer Processing of Pictorial Information
Homework 3: Road from Blobs to Faces to Seams

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***Abstract*—In this homework, I implemented various small algorithms: Anisotropic Diffusion, EigenFaces for Face Recognition and Seam Carving.**

I. Answers

A. Anisotropic Diffusion

1) Q.1 Effect of changing the value of $\mathcal{K}$: $\mathcal{K}$ controls the sensitivity to edges and was chosen empirically, depending upon the image.

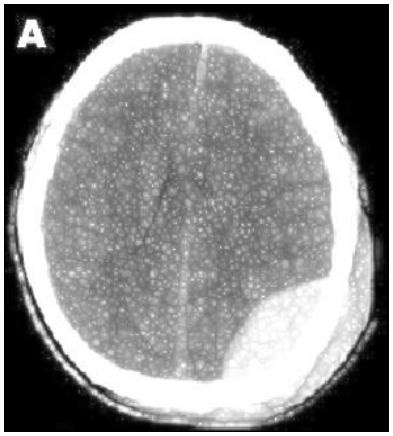

Fig. 1. Kappa: 0.3

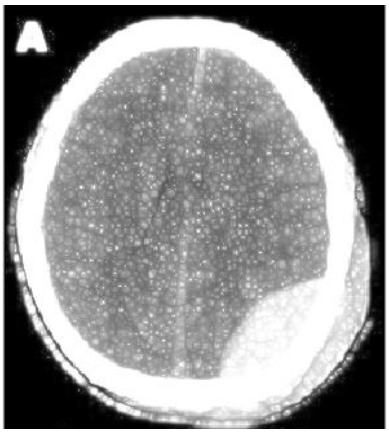

Fig. 2. Kappa: 1

Fig. 3. Kappa: 0.05

2) Q.2 Effect of changing the value of λ: The authors carefully took the value of λ between 0 and 0.25. We can see below in Fig.5, increasing the value of lambda has effects on intensity of the image.

Fig. 4. Lambda: 0.05

B. Eigen Faces

Training Accuracy: 94.7% Testing Accuracy: 86.4%

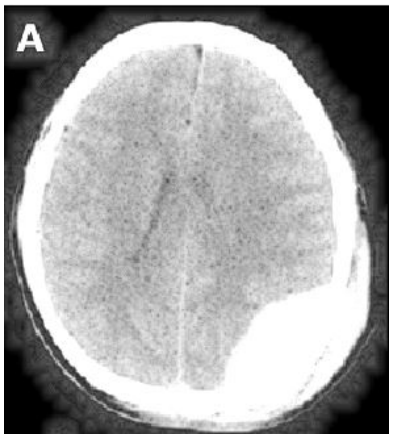

Fig. 5. Lamda: 0.5

1) Q3: It is true that for almost all cases, as M‘ increases, the recognition rate first decreases, then increases. There is a sweet spot for M‘ for which we get maximum RR.

2) Q4: This trend signifies that for each sample set, there will we only one sweet M‘ for which we will get maximum RR.

3) Q5 Drawbacks of using Eigen-faces for Face Recognition: Eigenfaces are sensitive to lightning, scale and translation *i.e.* it requires a highly controlled environment. Also, they cannot capture the human expression easily.

4) Q6: (a) Unlike Fisherfaces method, Eigen-faces method is vulnerable to illumination. The error varies linearly with the change in illuminance.

(b). Eigen-faces are rotational invariant. Eigenfaces seems to be robust enough to tolerate a reasonable amount of rotation error. This implies that it will be possible to recognize faces from far away, even if a direct frontal view is not possible.

(c). Eigen-faces use mostly low frequency information for recognition. It also implies that face recognition from far away is possible, at least if the face is looking at the camera!

C. Seam Carving

Fig. 6. Input Image

1) Q.8 Alternative Image Energy Function: Using the standard energy function (given in the Avidan-Shamir paper), few sections of the image sometimes distort after the reduction

Fig. 7. 500 H seams removed

Fig. 8. 100 H and 200 V seams removed

in either dimensions. One convenient property of seam carving is that the energy function is flexible and can be modified to improve the way images are seam carved, or to combine multiple elements. We know that the human visual perception is sensitive to gradient changes and the most extreme gradient changes occur at edges, so the energy calculation can be reformulated using edge-emphasizing filters something like:
First, a simple sobel filter, passed over the image both vertically and horizontally, acted to emphasize edges and gradient inconsistencies in textures, however, the sobel filter is prone to noise. Next, we can take a derivative of gaussian filter, first smoothing the image and then emphasizing edges. The derivative of gaussian filter proved more resistant to noise, and still emphasized edges well. We can play with the responses of the derivative of gaussian filter. It can be squared in order to get much stronger edge responses than any of the previous filters. By emphasizing edges, the seam-finding operation tend to avoid whole objects or well-defined regions, preserving what is likely important and noticeable content in the image.