Name: Arun Sharma
Student No: 50206920

Fall 2016 Homework Set 5

Ans: 1

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
0	0	1	1	1	1	1	0	0	0	0	1	1	1	0	0
0	0	1	1	1	1	1	0	0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0	0	1	1	1	1	1	0	0
0	0	0	1	1	0	0	0	1	1	1	1	1	0	0	0
0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0
0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0
0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0
0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0
0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The above is the binary matrix of dimension 16×16, the following structure element is

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

The above is the 3×3 structuring element.

(a) If we apply dilation in the above given 16×16 image & this 3×3 structuring element, we get the following image ~~matx~~ matrix.

(a)

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0
0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0
0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0
0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0
0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0
0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0
0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0
0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0
0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0

Dilation Operation

The above matrix is the result of the dilation operation on 16×16 image. * SE

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

(b)

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Erosion Operation

The above matrix is a result of erosion operation on a 16x16 ~~image~~ given image with SE $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

(c)

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0	1	0	1	0	0
0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0
0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0
0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hit miss operation.

(c) In the above image matrix, 4 structuring elements are used

$$\begin{bmatrix} & 1 & \\ 0 & 1 & 1 \\ 0 & 0 & \end{bmatrix} \begin{bmatrix} & 1 & \\ 1 & 1 & 0 \\ & 0 & 0 \end{bmatrix} \begin{bmatrix} & 0 & 0 \\ 1 & 1 & 0 \\ & 1 & \end{bmatrix} \begin{bmatrix} 0 & 0 & \\ 0 & 1 & 1 \\ & 1 & \end{bmatrix}$$

on a given 16x16 image.

Ans: 2a) Active Shape Models are the statistical based shaped model which captures variability in non-uniformaness of the shape from ~~the~~ ~~data~~ a set of images. It involves manual marking landmark points on the boundaries or the edge segments of the facial edges, hence it is based on edges and edge patterns. During alignment of the test image, ASM deals with various operation like rotation, translation ~~and~~, scaling, PCA etc and these landmark points eventually converges to get best ~~fit~~ fit on the test image.

b) Active Shape Model is widely used for face detection due to it's robustness and variability, since it is geometrically constraint, it is more suited for matching object boundaries rather than appearances such as emotions. Active Appearance Model can capture textures in order to capture emotions as well as location which may not be as accurate as ASM.

c) For capturing emotions of the training set of images. containing different emotions such as ~~happn~~ happiness, anger disgust, surprise and neutral ∴ the following algorithm describes to construct mean face of a person

1) Compute ASM of each shape sample as the linear combination of eigen vectors, $b_s = P_s^T(x - \bar{x})$
2) Through linear & non-linear interpolation, wrap each image to the mean shape
3) Normalize each image to average intensity and ~~unit variance~~ unit variance $\bar{g}$.
4) Perform PCA on normalized images.
5) Express each intensity sample as a linear combination of eigen vectors $b_g = P_g^T(g - \bar{g})$ represent sample gray-level parameter

6) concatenate shape coefficient b_s and gray level coefficient b_g

$$b = \begin{bmatrix} W b_s \\ b_g \end{bmatrix} = \begin{bmatrix} W P_s^T (x - \bar{x}) \\ P_g^T (g - \bar{g}) \end{bmatrix}$$

W is weighting daignol matrix

7) Apply PCA to the sample set of all b vectors, yielding ~~the~~

$$b = Q c$$

where Q containing eigen vectors and c are model coefficients signifies how model is different from mean shape and mean appearance. If c=0, model characterized as mean shape & appearance

~~d)~~ Emotions in the given problem can be ~~tagen~~ taken as training set of images. If we take c=0 from the last step of the above algorithm, we can get mean shape & appearance of all the emotions of the face.

(d) Active Appearance model represents object shape and its appearance via low dimensional subspace. It is widely used for fitting model ~~especially~~ especially in vedio sequence. ~~In the~~ For detecting emotions on a vedio sequence, one can take emotions as a set of image sequence (given 1000) in which each image consistute diffirent class of emotion. for ~~every~~ Given every class of emotion (anger, happiness, disgust, suprise & neutral) has equal number of sequence, we can calculate parameter c i.e. mean shape & mean apperance by setting it to 0. for each set of emotion. Hence, we can train the model on the given sets of ~~image~~ emotions & ~~to~~ test it on different images for different emotions.