

Assignment # 6
Digital Image Processing
Fundamentals, Spatial Transformations and Histogram

Submission Deadline: 30th May 2014

Total Questions: 08

Q1

Most of image processing based algorithms consist of three phases i.e. Preprocessing, feature extraction and classification. Based on this we are asked to design an algorithm for detection of different lesions from colored medical images. The medical problem which we are dealing with consists of two types of lesions i.e. bright and dark. The designed system consists of following steps

1. Preprocessing:

In preprocessing we generate a binary map for input image containing all possible lesion objects. It consist of following steps

- I. Extracting green channel from colored image as it is giving the best contrast for images under consideration
- II. Applying threshold on green channel to get binary image
- III. Removing objects with area less than 10 pixels to form final binary image

2. Feature Extraction:

In feature extraction, each region in binary image is represented with a number of features to ease the classification stage. Four features are extracted for each region

- I. Area (F1): which is the total number of 'on' pixels any region have in binary image.
- II. Mean green channel intensity (F2): It is the mean value of green channel intensities for all pixels inside any region.
- III. Normalized Energy (F3): It is the calculated by computing the sum of squares of green channel intensities and dividing it by total number of pixels any region have.
- IV. Mean Saturation (F4): It is the mean value of saturation for all pixels inside any region. Saturation is calculated from original colored image using expression given below

$$S = 1 - \frac{3}{(R + G + B)} [\min(R, G, B)]$$

3. Classification:

The last stage is classification for which we have two options available i.e. perceptron and minimum distance classifier. We are using these two because the data is linearly separable. This stage classifies each region in one of the possible output class which are dark or bright

Table -1 shows the training dataset for learning of perceptron and minimum distance classifier

Table-1: Dataset for question-1

F1	F2	F3	F4	Class
10	30	937	0.98	Dark
15	25	840	0.65	Dark
11	33	1015	0.93	Dark
9	29	947	0.85	Dark
15	98	1432	0.75	Bright

21	118	1120	0.79	Bright
24	121	1590	0.83	Bright
18	101	1005	0.78	Bright

Now a test colored image of size 10x10 is given to you in figure-1. Each pixel contains three values (R, G, B). For example for pixel (1,1), Red = 212, Green = 9 and Blue = 114. You have to apply the proposed system explained above to detect lesions from this image. Do following things

- I. Extract Green channel from given image
- II. An empirical threshold value of 24 for green channel is calculated. Apply this threshold to get binary image from green channel.
- III. Use 8-connectivity algorithm to find number of objects from binary image
- IV. Remove all those objects which have area less than 10 pixels
- V. Now for each object, calculate all four features and represents each object with a feature vector
- VI. Use perceptron learning algorithm to find weights for classification. Assume initial weights (w_0, w_1, w_2, w_3, w_4) are (0.5, 4.5, -56.5, 53.5, 0.5) and learning rate $\eta=0.1$
- VII. Classify each object from test image using learned weights
- VIII. Now apply minimum distance classifier to classify the objects from test image and compare the results with perceptron.

212, 9, 114	102, 10, 181	37, 22, 185	217, 3, 44	110, 20, 69	111, 15, 69	42, 7, 121	65, 17, 236	109, 21, 4	215, 2, 252
46, 34, 209	113, 18, 212	125, 25, 0	126, 28, 0	128, 30, 1	131, 33, 4	2, 1, 86	234, 11, 189	156, 21, 40	230, 8, 156
34, 24, 26	40, 16, 9	127, 28, 0	126, 28, 0	130, 32, 3	134, 37, 5	197, 21, 249	194, 4, 145	219, 2, 121	240, 17, 65
225, 8, 220	84, 12, 194	126, 28, 0	129, 31, 2	128, 31, 0	131, 34, 1	196, 4, 142	227, 19, 248	172, 14, 139	208, 13, 34
12, 9, 8	81, 12, 245	8, 12, 24	92, 22, 170	219, 1, 174	174, 1, 174	108, 22, 216	18, 7, 211	134, 22, 16	1, 25, 139
176, 22, 230	229, 24, 88	193, 22, 7	171, 117, 27	173, 119, 29	172, 121, 30	176, 124, 38	174, 124, 37	176, 126, 37	1, 19, 212
188, 9, 230	63, 3, 163	179, 12, 126	174, 123, 34	173, 122, 33	174, 122, 36	173, 121, 37	173, 123, 38	175, 125, 40	23, 15, 214
112, 4, 134	80, 7, 88	55, 13, 71	174, 122, 36	174, 122, 38	169, 117, 34	167, 115, 32	167, 115, 32	172, 121, 38	67, 8, 213
97, 13, 31	105, 12, 56	174, 13, 87	177, 125, 42	171, 118, 38	169, 113, 36	164, 108, 31	155, 102, 24	167, 114, 36	6, 7, 52
250, 22, 46	181, 15, 201	143, 6, 74	65, 10, 158	134, 16, 16	139, 23, 8	137, 17, 134	128, 1, 233	227, 20, 72	109, 23, 139

Figure-1: Colored image for question 1

Q2. Image Compression

Rainbow colors has following probabilities

V=0.3 I=0.3 B=0.13 G=0.1 Y=0.12 O=0.05

Carry out Huffman coding of above events and decode the following string from left to right

0000111010110001000000111

Q3. An image is corrupted with a noise of w_c frequency. Design a filter to remove this noise from the image. You have to provide following things

- 1) Type of frequency filter with its parameters values

2) Draw the profile of filter

3) Write down its mathematical expression

Q 4. Gray level co-occurrence matrix (GLCM) is used for texture analysis. A 2 bits/pixel texture image is given below. Construct its GLCM if position operator is defined as "**one pixel to right and one pixel down**".

1. Compute its probability matrix
2. Correlation
3. Contrast
4. Homogeneity
5. Entropy

1	1	2	3
0	1	2	0
1	1	1	2
0	1	3	0

Exercise Problems

4.13, 4.16, 4.27, 4.28, 4.29, 4.35,
8.8, 8.9, 8.10,
11.17, 11.19,
12.1, 12.2