COMP 411 Digital Image and Video Processing

Assignment I

Submission instructions:

1. Submission deadline: **22:00, 9 Oct 2022**.
2. Submission method: **Canvas**.
3. Name your folder to be your student number\_your name. eg.P01234567\_Mike.
4. For programming questions,
   1. All the files (including the input images and the source files**)** must be submitted in the same folder and are able to run without further settings.
   2. The marks are given based on the program correctness (70%), output(20%) and efficiency (10%).
5. No function except from *imread(), imwrite()* and *imshow()* from the IPCV toolbox of Scilab or SIP toolbox of Matlab is allowed for this assignment.
6. **ZERO MARK WILL BE GIVEN IF YOU COPY OTHERS’ WORK OR LET OTHERS COPY YOUR WORK!**
7. For image digitalization, answer the following questions.

**(Total: 20 marks)**

1. What is spatial Resolution? To increase the spatial Resolution of an image, what operation can be used? And why? [10 marks]

Spatial Resolution is the capability of the sensor to observe or measure the smallest object clearly with distinct boundaries.

To increase the spatial Resolution:

* **Make the size of every single pixel smaller (by oversampling):** Increase pixels per inch (PPI), which is one of the spatial resolution measurements.
* **Increase the number of pixels on the row or column of an image:** Spatial Resolution can be enlarged by increasing the pixel number in a row X or pixel number in column Y.

1. What is Dithering? What can dithering achieve? [10 marks]

**Dithering** is a process of juxtaposing pixels of two colors to create the illusion that a third color is present.

It can render images and graphics with more apparent colors than are actually displayable (from PPT). It can approximate a color by mixing other colors to achieve the result of “tricking” human eyes.

1. For a color image, are the following two histograms the same? And why?

1) the histogram of the value image of the color image

2) the average of R, G, B histograms of the color image.

**(Total: 10 marks)**

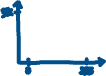
**NO.**

Value image (1) is calculated by , which means the arithmetic average of RGB value for every single pixel in the image. While what (2) calculates is the average number of pixels of every single gray level of RGB channels respectively. Therefore, in most cases, the results of the histogram will be different.

1. For a binary image, the number of black and white pixels are 5000 and 5000 respectively, calculate the entropy of the image and draw the histogram of the image.

Text, letter

Description automatically generated



1. Given a grayscale image ‘brain.bmp’, write a program in SCILAB/MATLAB to achieve the following tasks.

**(Total: 30 marks)**

1. Calculate and display the histogram of the image. [5 marks]
2. Calculate and display the pdf of the image. [5 marks]
3. Calculate and display the CDF of the image. [5 marks]
4. Generate a false colour image of the given image with 5 colours. Give darker colours to low grey levels and brighter colours to high grey levels. [10 marks]
5. Observe the false colour image and describe the abnormal thing you observed. [5 marks]

**Ans to 5:** The red zone is recognized specially among the large portion of the green area. Hence, it may possible that the red zone is abnormal, and it is circled in the image.

(Paste your code and display the result below)

Graphical user interface, application

Description automatically generated

**main.m:**

img = imread('./brain.bmp');

tiledlayout(2,2);

% (1) Calculate and display the histogram of the image

nexttile;

plot\_histogram(img);

% (2) Calculate and display the PDF of the image

nexttile;

plot\_pdf(img);

% (3) Calculate and display the CDF of the image

nexttile;

plot\_cdf(img);

% (4) Generate a false color image of the given image with 5 colors. Give darker colors to low grey levels and brighter colors to high grey levels

nexttile;

false\_img = false\_image(img);

imshow(false\_img);

% (5) Observe the false color image and describe the abnormal thing you observed

% The red zone is recognized specially among the large portion of the green

% area. Hence, it may possible that the red zone is abnormal and it is

% circled in the image.

**plot\_histogram.m:**

function histogram = plot\_histogram(img)

[~, ~, channel] = size(img);

hist = zeros(1, 256, channel);

for g = 0:255

hist(1, g+1, :) = sum(sum(img == g, 1), 2);

end

if channel == 3

plot(0:255, hist(1, :, 1), 'r', 0:255, hist(1, :, 2), 'g', 0:255, hist(1, :, 3), 'b');

title('Histogram (colored)');

xlabel('g');

ylabel('pixels');

else

plot(0:255, hist(1, :, 1));

title('Histogram (monochrome)');

xlabel('g');

ylabel('pixels');

end

histogram = hist;

end

**plot\_pdf.m**

function distribution = plot\_pdf(img)

[row, column, ~] = size(img);

hist = plot\_histogram(img);

pdf = hist / (row \* column);

plot(pdf);

title('Probability Distribution Function');

xlabel('intensity');

ylabel('probability');

distribution = pdf;

end

**plot\_cdf.m**

function distribution = plot\_cdf(img)

pdf = plot\_pdf(img);

cdf = zeros(256, 1);

for i = 1:256

cdf(i) = sum(pdf(1:i));

end

plot(cdf);

title('Cumulative Distribution Function');

xlabel('intensity');

ylabel('probability');

distribution = cdf;

end

**false\_image.m:**

function image = false\_image(img)

[rows, cols] = size(img);

false\_img = zeros(rows, cols, 3);

% five colors: blue, green, magenta, red, cyan

colors = [0, 0, 255; 0, 255, 0; 255, 0, 255; 255, 0, 0; 0, 255, 255];

% ranges for each color from 1 ... 255

ranges = [1, 51; 52, 102; 103, 153; 154, 204; 205, 255];

for i = 1:rows

for j = 1:cols

for k = 1:5

if img(i, j) >= ranges(k, 1) && img(i, j) < ranges(k, 2)

false\_img(i, j, :) = colors(k, :);

end

end

end

end

image = false\_img;

end

1. Find two grayscale images and write a program in SCILAB/MATLAB to achieve the following tasks.

**(Total: 30 marks)**

1. Display the two images in parallel in the same window and give a title to each image; [5 marks]
2. Generate a new image by subtracting these two images with different weights, e.g. *0.4 \*img1+0.8\*img2*; [10 marks]
3. Display and store the new image as ‘addition.bmp’. [5 marks]
4. Discuss in which condition the whole new image is totally white and explain why. [10 marks]

Note: the program should only support grayscale images with the same sizes so certain checking is needed before subtraction.

(Paste your code and display the result below)

Graphical user interface, website

Description automatically generated

**main.m:**

p1 = imread("p1.tif");

p2 = imread("p2.tif");

tiledlayout(1, 3);

nexttile;

imshow(p1)

title("lena")

nexttile;

imshow(p2)

title("mandril")

% Generate a new image by subtracting these two images with different weights, e.g. 0.4 \*img1+0.8\*img2

new\_image = 1.2 \* p1 + 1.2 \* p2;

% (4) in which condition the whole new image is totally white ?

% for each pixel, if the addition of the two images is greater than 255

% then the pixel is white, hence if the whole new image is totolly white, then

% every single pixel in the new image is greater than 255

imsave("addition.bmp")

nexttile;

imshow(new\_image)

title("new image")