Multimedia Systems Lecture 2

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Digital Images

- An image can be defined as two-dimension function f(x,y) where x and y are the pixel coordinates and f(x,y) is the value of light or intensity.
- It can be defined as a form of digital signal where x and y are signal dimensions and f(x,y) is the value of the signal.
- Digital Image processing is considered as a subset of digital signal processing.
- In Matlab images can be of type double where their value ranges from 0 to 1 or of type uint8 where their value ranges from 0 to 255.
- im2double can be used to convert an image to double and im2uint8 can be used to convert an image to uint8.

Image Types

- Rasterized images: These images are represented by a matrix of pixels where each pixel has an intensity level that defines its color.
- They lose their resolution and become blurry when resizing.
- These images can be created using Adobe Photoshop or GIMP software.
- Vector images: These images are represented by line drawing commands, where each command defines the start and end of the line.
- These images retain their resolution even after resizing.
- These images can be created using Adobe Illustrator, Inkscape.

Reading Images

- In Matlab we can use the imread function to read image files
- Image = imread(‘sunflower.jpg’);
- Image is x*y*3 matrix where x and y are image dimensions.
- The third dimension specifies the intensity values for red (1), green (2) and blue (3).
- To display an image we use imshow(Image).
- We can get image information using imfinfo(‘sunflower.jpg’);
- The result contains the image’s name, Modification date, size, format, dimensions, bit depth and color type.
- Bit depth is the number of bits allocated to each color.

Operations on Rasterized images

- To load and show an image use these commands
  - Image = imread(‘greens.jpg’);
  - imshow(Image);
- Rotation: images can be rotated using imrotate function as follows
  - Rotated_image = imrotate(Image,45);
  - imshow(Rotated_image);
- The first parameter is the image to rotate and the second one is the rotation angle in degrees not radians.

Operations on Rasterized images

- Resizing: images can be resized with imresize function as follows:
  - Re1 = imresize(Image,3)
  - imshow(Re1);
  - Re2 = imresize(Image,[200 200]);
  - imshow(Re2);
- The first parameter is the image to resize, and the second one is either the scale or the dimensions of the new image.
- Cropping: It is used to remove some part of the image, use the imcrop function
  - Cropped = imcrop(Image,[20 20 90 70]);imshow(Cropped)
  - The first parameter is the image matrix and the second parameter is 4 value vector as follows: XMIN, YMIN, Width,Height

Color Models

- RGB: In this model each pixel is represented by three bytes that represent red, green and blue intensity.
- In Matlab this is represented by a matrix of size x*y*z where x and y are pixel coordinates and z is 1 for red and 2 for green and 3 for blue.
- CMYK: This model is designed for printers.
- RGBA: This model adds an extra byte to RGB model to represent the transparency.
- Gray Scale: Each pixel is represented by one byte which defines a shade of gray color.

Color Models

- Indexed Images: These are used with any other color model to reduce the storage capacity of an image.
- Color are usually repeated in an image, so a table is used to store the color code and an index to the color is used as the pixel value.
- Binary: This is the oldest form of images, each pixel is represented by one bit, 0 for black and 1 for white.
- To convert from RGB to Indexed we use rgb2ind
- [rgb_table rgb_map] = rgb2ind(Image,256)
- Imshow(rgb_table,rgb_map)
- The second parameter is the number of colors in the table.

Color Models

- To convert from index to rgb we use ind2rgb
- Rgb_restored = ind2rgb(rgb_table,rgb_map);
- imshow(Rgb_restored);
- We use gray2ind to convert gray scale images to indexed images.
- We use ind2gray to convert indexed images to gray images.
- To convert from rgb to gray scale we can use this formula
- Gray = (R+G+B)/3
- Gray = (rgb(:,:,1)+rgb(:,:,2)+rgb(:,:,3))/3
- imshow(Gray)

Color Models

- Matlab has another function to convert rgb images to gray scale images, it is rgb2gray
- Gray_2 = rgb2gray(rgb);
- imshow(Gray_2);

Histogram

- Histogram provides statistical view of colors or shades of gray in an image.
- To create a histogram of an image we use imhist function
  - R = imhist(Image(:,:,1));
  - G = imhist(Image(:,:,2));
  - B = imhist(Image(:,:,3));
  - Range = [0:255];
  - Plot(Range,R,’r’,Range,G,’g’,Range,B,’b’);

Histogram

- Contrast modification: Contrast is the difference in color that makes an object distinguishable.
- We can change contrast of an image using histeq function
- Image1 = histeq(Image);
- subplot(2,2,1),imshow(Image),title(‘original image’);
- subplot(2,2,2),plot(imhist(Image1)),title(‘original image histogram’);
- subplot(2,2,3),imshow(Image1),title(‘modified image’);
- subplot(2,2,4),plot(imhist(Image1)),title(‘modified image histogram’);

Histogram

- We can change contrast using imadjust function, which enables us to replace a range of colors with a new one.
- subplot(3,2,1),imshow(Image),title('original image');
- subplot(3,2,2),plot(imhist(Image)),title('original image histogram');
- Image1=imadjust(Image,[0.2 0.7],[0.4 0.6]);
- subplot(3,2,3),imshow(Image1),title('modified image 1');
  - subplot(3,2,4),plot(imhist(Image1)),title('modified image 1 histogram');
- Image2=imadjust(Image,[0.4 0.6],[0.2 0.7]);
- subplot(3,2,5),imshow(Image2),title('modified image 2');
- subplot(3,2,6),plot(imhist(Image2)),title('modified image 2 histogram');

Exercise

- Write a Matlab script to:
  - Read an image name from standard input.
  - Display the image’s properties.
  - Scale the image by a factor of 2.
  - Crop the upper left quarter of the image before scaling.
  - Display the original image, scaled image and cropped image.
  - Convert the image to a gray level image and write it to a file called gray-image.jpg.
  - Apply histeq to the image.
  - Draw the gray scale image and its histogram then draw the new image after applying histeq and its histogram.

THE END