University of Diyala
Computer Science Department
Image Processing
3rd Class
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Image Processing

معالجة صور

2nd lecture

What is a digital image?

An image maybe defined as a two-dimension function $f(x, y)$, where (x, y) are spatial (plane) coordinates and f is the amplitude of the point (x, y) in the image, also means its gray or intensity. Especially, when (x, y) and f are finite and discrete quantities, the image is called as the digital image. Each point in a digital image is called as a pixel.

Writing images

Images are written to disk using function `imwrite`, which has the following basic syntax:

```
imwrite(f, 'filename')
```

For example, the following command writes f to a jpeg file named third_stage :

```
>> imwrite ( f, 'E:\ image processing\ third_stage.jpg');
```

A more general `imwrite` syntax applicable only to JPEG images is

```
imwrite(f, 'filename.jpg', 'quality', q)
```

where `q` is an integer between 0 and 100 (the lower the number the higher the degradation due to JPEG compression).

For example,

```
>> imwrite ( f, ' E:\ image processing\ third_stage.jpg ', ' quality ' , 25);
```

In order to get an idea of the compression achieved and to obtain other image file details, we can use function `imfinfo`, which has the syntax

```
imfinfo filename
```

where `filename` is the *complete* file name of the image stored in disk. For example,

```
>> imfinfo 'E:\image processing\third_stage.jpg'
```

ans =

Filename: 'E:\image processing\third_stage.jpg'
FileModDate: '15-Mar-2016 22:40:15'
FileSize: 13573
Format: 'jpg'
FormatVersion: ''
Width: 512
Height: 512
BitDepth: 8
ColorType: 'grayscale'
FormatSignature: ''
NumberOfSamples: 1
CodingMethod: 'Huffman'
CodingProcess: 'Sequential'
Comment: {}

Data Classes

Name	Description
`double`	Double-precision, floating-point numbers in the approximate range -10^{308} to 10^{308} (8 bytes per element).
`uint8`	Unsigned 8-bit integers in the range [0, 255] (1 byte per element).
`uint16`	Unsigned 16-bit integers in the range [0, 65535] (2 bytes per element).
`uint32`	Unsigned 32-bit integers in the range [0, 4294967295] (4 bytes per element).
`int8`	Signed 8-bit integers in the range [−128, 127] (1 byte per element).
`int16`	Signed 16-bit integers in the range [−32768, 32767] (2 bytes per element).
`int32`	Signed 32-bit integers in the range [−2147483648, 2147483647] (4 bytes per element).
`single`	Single-precision floating-point numbers with values in the approximate range -10^{38} to 10^{38} (4 bytes per element).
`char`	Characters (2 bytes per element).
`logical`	Values are 0 or 1 (1 byte per element).

Image Types

Digital images can broadly classified under several categories; Binary Images, Grayscale Images and Color Images.

Binary images

The minimum number of bits that can be used to represent a pixel is one, and an image that consists of signal-bit data is called a binary image. Such an image contains pixels which are either black (switched off) or white (switched on) and are represented by the pixel values 0 and 1 respectively. Binary images require less storage space than other types of images, although the information that can be stored in these binary image files is greatly reduced.

Grayscale images

If each pixel in a monochrome image can take more than two values, a grayscale image results. Four-bit data allows each pixel to have one of 16 (i.e. 2^4) gray levels. This range of gray levels is known as a grayscale, ranging from pure black at one extreme to pure white at the other; pixel intensities between 0 and 15 are various shades of gray. Eight bits is the most popular image depth in which each pixel can represent one of 256 grayscale values and therefore the amount of information that can be stored by these images is greater than can be stored by four-bit images.

Color images

The two most common ways of storing color image contents are; RGB representation in which each pixel is usually represented by a 24-bit number containing the amount of its red (R), green (G), and blue (B) components, and indexed representation where a 2D array contains indices to a color palette (or lookup table (LUT). 24-Bit (RGB) color images can be represented using three 2D arrays of same size, one for each color channel: red (R), green (G), and blue (B). Each array element contains an 8-bit value, indicating the amount of red, green, or blue at that point in [0, 255] scale. The combination of the three 8-bit values into a 24-bit number allows 224 (16,777,216, usually referred to as 16 million or 16 M) color combinations.

Adjacent to RGB image and indexed image, there are other color spaces whose use in a number of applications may be far more convenient in addition to appropriate. For example; NTSC, YCbCr, HVS, CMY, CMYK, and CMY color spaces.