



BASIC INTRODUCTION TO IMAGE PROCESSING

Yemi .O
08/24/2017



Agenda



Background

Image - Pixel Concept

Types of Images

RGB Model & Color Code

Color Quantization

Basic Manipulation

Application

R packages

R Script

Background

Conversion of 2D spatial information in images into other forms that can be used for content characterization

Image processing deals with manipulation of digital images through a digital computer

AI Subfield: Computer Vision

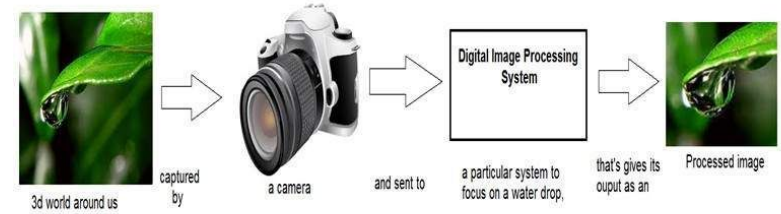


Image: Definition

2 D signal

It is defined by the mathematical function $f(x,y)$

x and y are the two co-ordinates

two dimensional array of numbers ranging between 0 and 255.

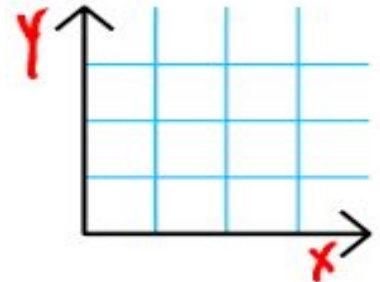


Image: Pixel (PEL)

Pixel is the smallest element of an image

Each pixel correspond to any one value.

The **value of a pixel** at any point correspond to the **intensity of the light photons** striking at that point

Bits per pixel (Bpp) denotes the number of bits per pixel.

The **number of different colors** in an image depends on **the depth of color or bits per pixel**.

Numbers represented by one bit (0,1)

In an 8-bit gray scale image, the value of the pixel between 0 and 255.



$$(2)^{bpp}$$

image: Types

Binary image

- Two pixel values (0,1)
- Monochrome
- Format: Portable Bit Map (PBM)

8 bit Color

- 256 different shades of colors
- Grayscale image.
- Color range: 0-255. {0: black, 127 : Gray, 255 : White}
- Format: Portable Gray Map (PGM)
- Matrix size: 1

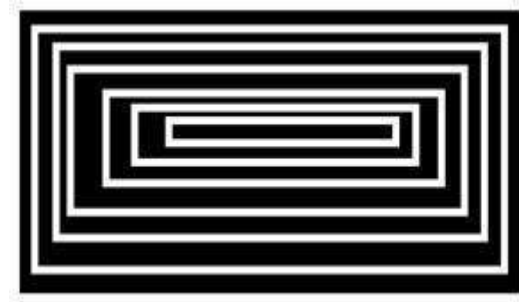


Image: Types

16-bit color format

- Known as high color image format
- Red ,Green and Blue (RGB) format
- 65,536 different colors

24- bit color format

- True color format
- RGB
- Format: Portable PixMap (PPM)

Matrix size: 3

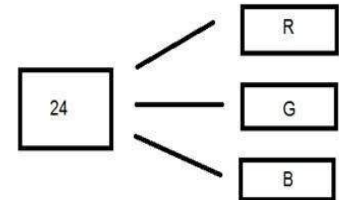
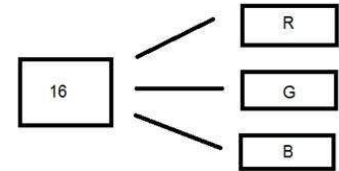
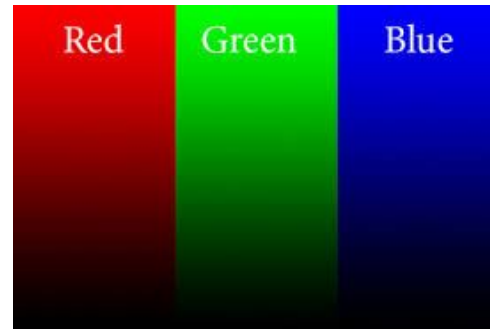


Image: RGB Model/Color Codes

Using the RGB model

Binary color

- Color: Black ; white
- Decimal code: (0,0,0); (255,255,255)



RGB Model

- Color: Red;Green
- Decimal code: (255,0,0);(0,255,0);(0,0,255)



Gray Color

- Decimal code:(128,128,128)



Image: Color Quantization

Division of a signal into partitions(quanta)

Color quantization is applied when the color information of an image is to be reduced.

24-bit color image is transformed into an 8-bit color image

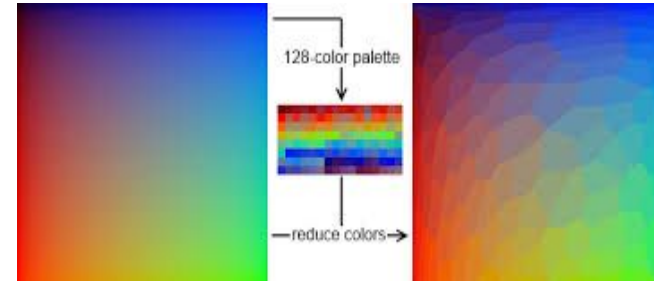


Image : Manipulation



- Brightness & Contrast
- Gamma Correction
- Color Change
- Blurring

Brightness & Contrast

Brightness

- Brightness refers to the overall lightness or darkness of an image
- Brightness can be increased or decreased by **addition (+)** or **subtraction(-)**, to the image matrix.

Contrast

- Contrast is the difference between **maximum** and **minimum pixel intensity** in an image.

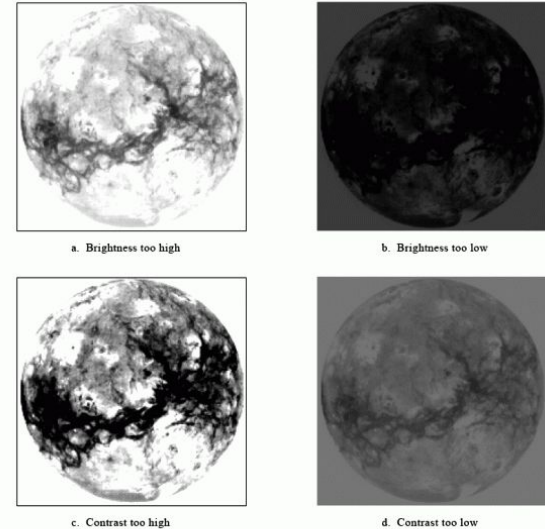


FIGURE 23-10
Brightness and contrast adjustments. Increasing the *brightness* makes every pixel in the image becomes lighter. In comparison, increasing the *contrast* makes the light areas become lighter, and the dark areas become darker. These images show the effect of misadjusting the brightness and contrast.

Gamma Correction

Gamma correction

- non-linear adjustment to individual pixel values
- Defines the relationship between a **pixel's numerical value** and its **actual luminance**
- defined by the **power-law expression**
- (where A is a constant and the input and output values are non-negative real values; in the common case of $A = 1$, inputs and outputs are typically in the range 0–1.)

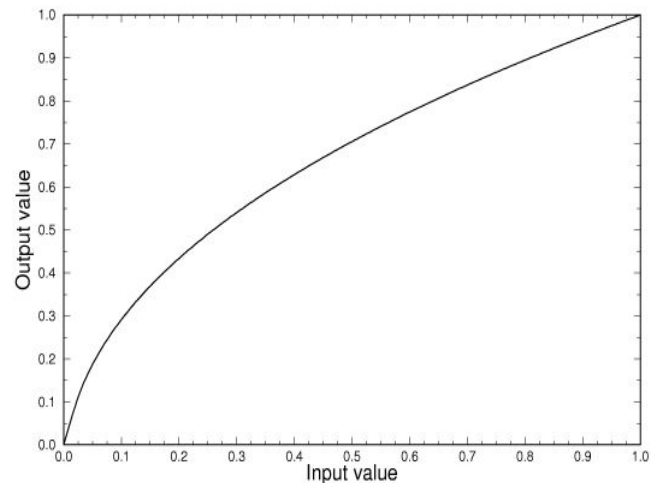
$\gamma < 1$: Gamma compression

- Gamma encoding is used to increase the quality of shadow values when an image is stored as integer intensity values, so to do gamma encoding you use the formula:
- $\text{encoded} = ((\text{original} / 255) ^ (1 / \gamma)) * 255$

$\gamma > 1$: Gamma expansion

- Gamma decoding is used to restore the original values, so the formula for that is:
- $\text{original} = ((\text{encoded} / 255) ^ \gamma) * 255$

$$V_{\text{out}} = AV_{\text{in}}^\gamma$$



ColorMode



Grayscale

Monochrome

Color

Blurring: Gaussian function

- Result of blurring an image by a Gaussian function
- The Gaussian blur is a type of image-blurring filter that uses a Gaussian function for calculating the transformation to apply to each pixel in the image.
- **(G expresses the normal distribution in statistics)

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}}$$

$$G(x, y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$



Original



StDev = 3



StDev = 10

Applications of Digital Image Processing

- Medical field
- Remote sensing
- Microscopic Imaging
- Social media

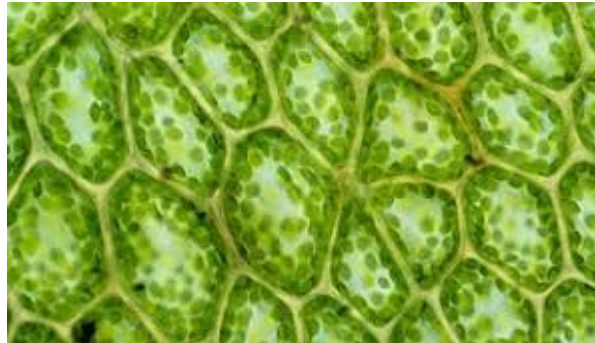
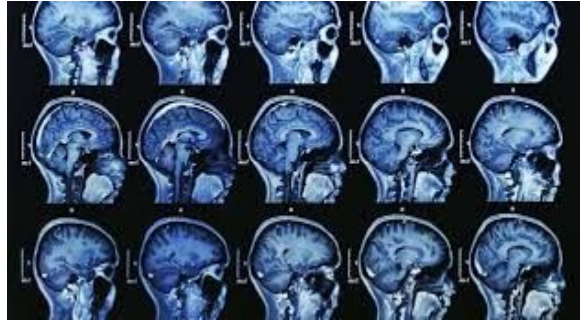


Image : R packages



EBImage

Imager

ImageMagick