Image Resolution and Representation (LEC 3)

3-1 The quality of the digital image:

The quality of digital image is directly related to the **Number of pixel** and **lines** along with the range of brightness values, in the image. These aspects are known as image Resolution

Image resolution: is the capability of the digital image to resolve the elements of the original sense.

For **digital image**, the resolution characteristic can be broken in to two Primary parts:

1- Spatial resolution.

2-Brightness resolution or (color resolution) in the image color.

3-2 Spatial resolution:

The term spatial refers to the concept of the space- in our case, two dimension image spaces.

-We use the term spatial resolution to describe how many pixels comprise s digital image. The more pixels in the image, the greater are spatial resolution, the number of pixels in a digital image into discrete pixels.

The **measurement** of digital image's spatial resolution is related to two distinct measurements – it

1- Spatial density.

2- Optical resolution.

Spatial density: is the measurement of the number of pixels in digital image.

Optical resolution: on the other hand is the measurement of the capability of how will the entire physical imaging's systems can resolve the spatial details of an original sense.

- Whichever is less –the spatial density or optical resolution dictates an image's spatial resolution.
- We will assume that the optical resolution is always better than the spatial density, and that the spatial density alone.

The concept of **spatial frequency** can explain how finally we should sample an image. All images contain details, some fine details and some coarse details. The **details** are made up of **brightness transitions** that cycle from **dark to light** and back to **dark**. The rate at which brightness cycle.

The resolution has to do with ability to separate two adjacent pixels as being separate, and then we can say that we can resolve the two. The concept of resolution is closely tied to the concepts of spatial frequency.

Spatial frequency concept, frequency refers to how rapidly the signal is changing in space, and the signal has two values for brightness-0 and maximum. if we use this signal for one line (row) of an image and then repeat the line down the entire image, we get an image of vertical stripes. If we increase this frequency the strips get closer and closer together, until they finally blend together.

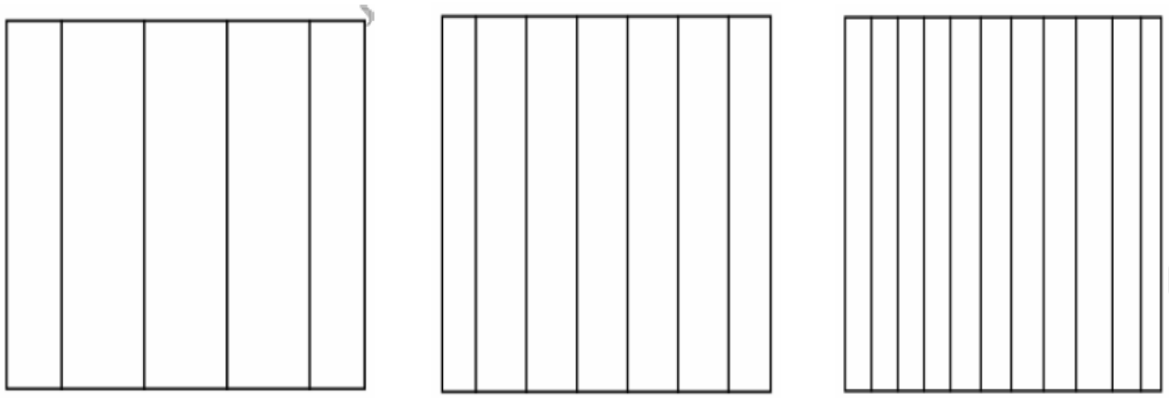


FIGURE (2.2): Resolution and Spatial Frequency

3.3 Image Representation

We have seen that the human visual system (HVS) receives an input image as a collection of spatially distributed light energy; this is form is called an optical image. Optical images are the type we deal with every day –cameras captures them, monitors display them, and we see them. The digital image I (r, c) is represented as a two- dimensional array of data, where each pixel value corresponds to the brightness of the image at the point (r, c). In linear algebra terms, a two-dimensional array like our image model I(r, c) is referred to as a matrix, and one row (or column) is called a vector. The image types we will consider are:

1. Binary Image

Binary images are the simplest type of images and can take on two values, typically black and white, or '0' and '1'. A binary image is referred to as a 1 bit/pixel image because it takes only 1 binary digit to represent each pixel.

These types of images are most frequently in computer vision application where the only information required for the task is general shapes, or outlines information. For example, the optical character recognition (OCR).

Binary images are often created from gray-scale images via a threshold value is turned white (‘1’), and those below it are turned black (‘0’).

2. Gray Scale Image:

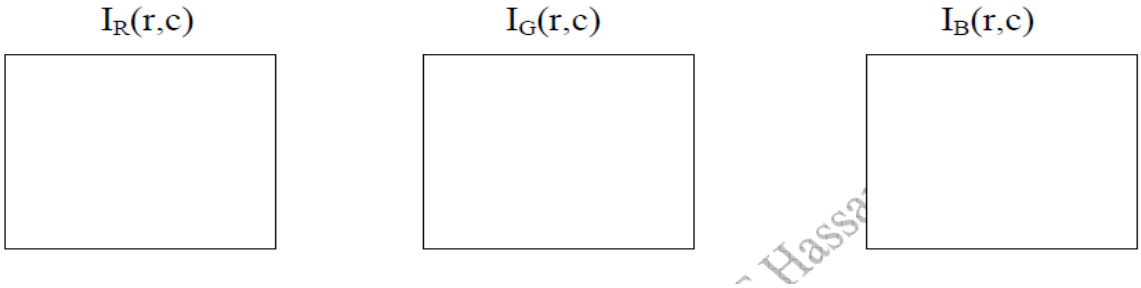
Gray-scale images are referred to as monochrome, or one-color image. They contain brightness information only brightness information only, no color information. The number of different brightness level available.

The typical image contains 8 bit/ pixel (data, which allows us to have (0-255) different brightness (gray) levels). The 8 bit representation is typically due to the fact that the byte, which corresponds to 8-bit of data, is the standard small unit in the world of digital computer.

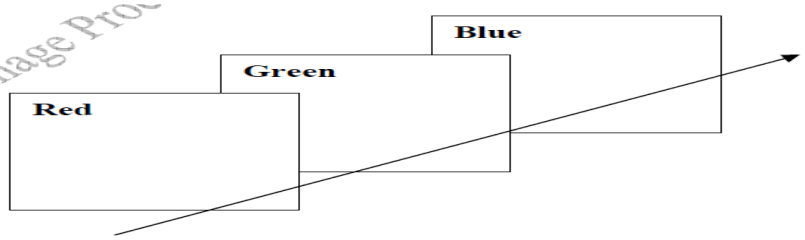
3. Color Image

Color image can be modeled as three band monochrome image data, where each band of the data corresponds to a different color.

Typical color images are represented as red, green, and blue or RGB images .using the 8-bit monochrome standard as a model, the corresponding color image would have 24 bit/pixel – 8 bit for each color bands (red, green and blue). The following figure we see a representation of a typical RGB color image.

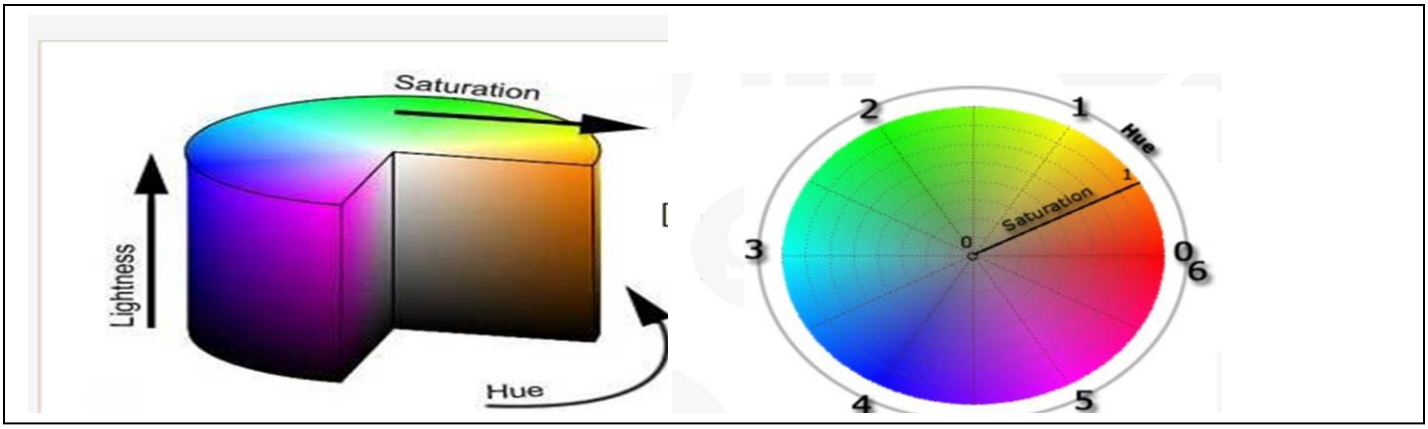


The following figure illustrate that in addition to referring to arrow or column as a vector, we can refer to a single pixel red ,green, and blue values as a color pixel vector –(R,G,B).



For many applications, RGB color information is transformed into mathematical space that decouples the brightness information from the color information.

The hue/saturation /lightness (Luminance) (HSL) color transform allows us to describe colors in terms that we can more readily understand.



The lightness is the brightness of the color, and the hue is what we normally think of as "color" and the hue (ex: green, blue, red, and orange).

The saturation is a measure of how much white is in the color (ex: Pink is red with more white, so it is less saturated than a pure red).

Example: "a deep, bright orange" would have a large intensity ("bright"), a hue of "orange", and a high value of saturation ("deep").we can picture this color in our minds, but if we defined this color in terms of its RGB components, R=245, G=110 and B=20.

Modeling the color information creates a more people oriented way of describing the colors.

4. Multispectral Images

Multispectral images typically contain information outside the normal human perceptual range. This may include infrared (,(**الحمراء تحت** ultraviolet (**البنفسجيه فوق**), X-ray, acoustic or radar data. Source of these types of image include satellite systems, underwater sonar systems and medical diagnostics imaging systems.

Digital Image File Format (LEC 4)

Many image types can be converted to one of other type by easily available image conversion software. Field related to computer imaging is that computer graphics.

4-1Computer Graphics:

Computer graphics is a specialized field within that refers to the computer science realm that refers to the reproduction of visual data through the use of computer.

In computer graphics, types of image data are divided into two primarily categories:

1. **Bitmap image (or raster image):** can represented by our image model I(r, c), where we have pixel data and corresponding brightness values stored in file format.

2. **Vector images**: refer to the methods of representing lines, curves shapes by storing only the key points. These key points are sufficient to define the shapes, and the process of Turing theses into an image is called rendering (displayed or printed), after the image has been rendered, it can be thought of as being in bit map format where each pixel has specific values associated with it.

Most the type of file format fall into category of bitmap images. In general, these types of images contain both ***header*** information and the ***raw pixel data***. The header information contain information regarding

1. The number of rows(height)
2. The number of columns(Width)
3. The number of bands.
4. The number of bit per pixel.
5. The file type
6. Additionally, with some of the more complex file formats, the header may contain information about the type of compression used and other necessary parameters to create the image, I(r,c).

4-2 Image File Formats :

1. BMP format:

It is the format used by the windows, it's a compressed format and the data of image are located in the field of data while there are two fields , one for header (54 byte) that contains the image information such as (height ,width , no. of bits per pixel, no of bands , the file type).

The second field is the color map or color palette for gray level image, where its length is 0-255).

2. Bin file format:

It is the raw image data I(r,c) with no header information.

3. PPM file format :

It contain raw image data with simplest header, Netpbm format is a family including the **portable pixmap** file format (PPM), the **portable graymap** file format (PGM) and the **portable bitmap** file format (PBM). These are either pureASCII files or raw binary files with an ASCII header that provide very basic functionality and serve as a lowest-common-denominator for converting pixmap, graymap, or bitmap files between different platforms. Several applications refer to them collectively as PNM format (Portable Any Map).

4. TIFF(Tagged Image File Format) and GIF(Graphics Interchange Format):

The **TIFF** (Tagged Image File Format) format is a flexible format that normally saves 8 bits or 16 bits per color (red, green, blue) for 24-bit and 48-bit totals, respectively, TIFF image format is not widely supported by web browsers. TIFF remains widely accepted as a photograph file standard in the printing business.

GIF (Graphics Interchange Format) is limited to an 8-bit palette, or 256 colors. This makes the GIF format suitable for storing graphics with relatively few colors such as simple diagrams, shapes, logos and cartoon style images. The GIF format

supports animation and is still widely used to provide image animation effects. It also uses a lossless compression that is more effective when large areas have a single color, and ineffective for detailed images or dithered images.

5. JPEG (Joint photo Graphic Experts Group):

It is simply becoming standard that allows images compressed algorithms to be used in many different computer platforms.

JPEG images compression is being used extensively on the WWW. It's, flexible, so it can create large files with excellent image equality.