Type of image

The image types we will consider are :

1) Binary 2) grayscale 3) color 4) multispectral.

The more general term pixmap refers to a map of pixels, where each one may store more than two colors, thus using more than one bit per pixel. Often bitmap is used for this as well

1. Binary Images (Black and White Images) (monochrome 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 used in computer vision applications where the only information required for the task is general shape or outline, information.

Binary images are often created from gray-scale images via a threshold operation where every pixel above the threshold value is turned white ('1'), and those below it are turned black ('0').

- Each pixel is stored as a single bit (0 or 1).
- A 640 x 480 bit-mapped image requires 37.5 KB of storage.

2. Gray-Scale Images

Gray-scale images are referred to as monochrome, or one-color, images. They contain brightness information only, no color information. The number of bits used for each pixel determines the number of different brightness levels Available. The typical image contains 8 bits/pixel data, which allows us to have 256 (0-255) different brightness (gray) levels. This representation provides more than adequate brightness resolution, in terms of the human visual system's requirements and provides a "noise margin" by allowing for approximately twice as many gray

levels as required. Additionally, the 8 bit representation is typical due to the fact that the byte which corresponds to 8 bit of data, is the standard small unit in the world of digital computers.

Each pixel is usually stored as a byte (value between 0 to 255). A dark pixel may have a value of 10; a bright one may be 240 (dark=0; white=255)

Example: find image size with 640*480 pixles

Total no. of bits = 640*480* 8 bit=2457600 bit Or 640*480*1 Byte=307200 Bytes

Convert to Byte: 2457600/8=307200 Byte

Convert to KByte: 307200 Byte/1024 = 300 KB

3. Color Images

Color images in image processing are those that contain information about the colors of the objects in the scene. Unlike grayscale images, which represent only intensity variations, color images include information about the colors of the different points in the image. In digital image processing, color images are commonly represented using the RGB color model.

RGB Color Model: In the RGB color model, each pixel in an image is represented as a combination of three primary colors: Red, Green, and Blue. The intensity of each color can vary from 0 to 255, where 0 represents the absence of that color and 255 represents the maximum intensity. By combining different intensities of these three colors, a wide range of colors can be created.

For example, a pixel with an RGB value of (255, 0, 0) represents pure red because the red component is at its maximum, and green and blue are at their minimum. Similarly, (0, 255, 0)

represents pure green, and (0, 0, 255) represents pure blue. Combining these three primary colors in different proportions allows the creation of various colors.

Example: Let's consider a simple example of a color image. Suppose we have a 2x2 pixel image with RGB values as follows:

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Pixel 1: (255, 0, 0)   Pixel 2: (0, 255, 0)
Pixel 3: (0, 0, 255)   Pixel 4: (255, 255, 0)
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In this example:

- Pixel 1 is pure red.
- Pixel 2 is pure green.
- Pixel 3 is pure blue.
- Pixel 4 is a combination of red and green, resulting in yellow.

When these pixels are combined, they form a small color image where each pixel contributes to the overall color composition. In more complex images, this process is repeated for each pixel, resulting in a full-color image with a wide range of colors. Image processing techniques for color images involve manipulating these RGB values to enhance or modify the visual appearance of the image.

24-Bit Color Images

How many colors in RGB model?

In a color 24-bit image, each pixel is represented by three bytes, usually representing RGB. Since each value is in the range 0 255, this format supports 256 × 256 × 256, or a total of 16,777,216, possible combined colors. However, such flexibility does result in a storage penalty: a 640 × 480 24-bit color image would require 921.6 kB of storage without any compression.

Total bits=Width×Height×Bits per pixel

Total bits=640×480×24 =640×480×24

Total bits=9,216,000Total bits=9,216,000

So, a 640 × 480 24-bit color image would require 9,216,000 bits, which is equivalent to 9,216 kilobits (Kb) or 9.216 megabits (Mb).

Color images are actually stored as 32-bit images, with the extra byte of data for each pixel used to store an alpha value representing special effect information (e.g., transparency).

Examples: Color Image uses 32 bits with high = 200 and width = 200 pixels?

Size= 200*200*4 Bytes=160000B/1024=156.25KB.

4. Multispectral Images

Multispectral images are like special photos that show more than just what our eyes can see. Instead of the usual colors in a photo, like red, green, and blue, multispectral images use a variety of colors, each showing different parts of light that are invisible to us.

So, multispectral images are like super-powered photos that reveal hidden details in things like plants, landscapes, or even in medical images. They help us understand the world in a more detailed and specialized way.

Example:

Imagine you have a farm, and you want to know how healthy your crops are. You take a regular photo, and everything might look green. But if you use a multispectral camera, it can capture not only the greenness but also other information like how much infrared light the plants are giving off. This extra information helps you understand the health of your crops in a way that a regular photo cannot.

Image file formats:

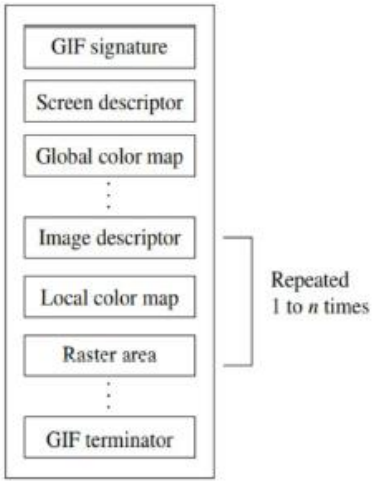
Some popular file formats are listed in the table below with their respective extensions:

Format:

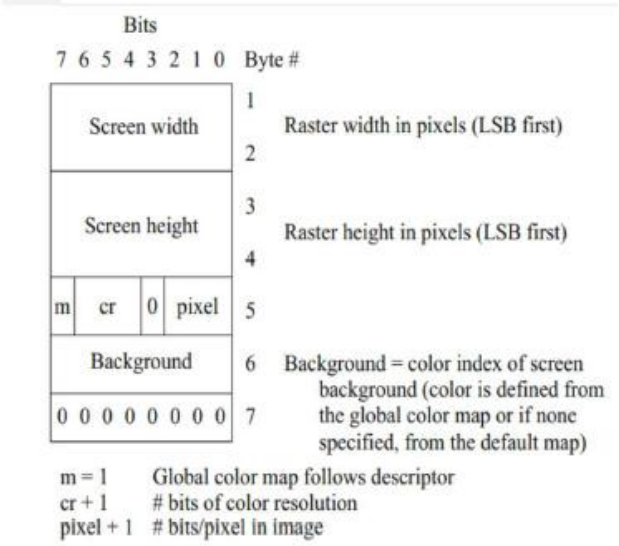
Format Name	Description	Recognized Extensions
GIF	Graphics Interchange Format	.gif
JPEG	Joint Photographic Experts Group	.jpg, .jpeg
TIFF	Tagged Image File Format	.tif, .tiff
BMP	Windows Bitmap	.bmp
PNG	Portable Network Graphics	.png

1- GIF

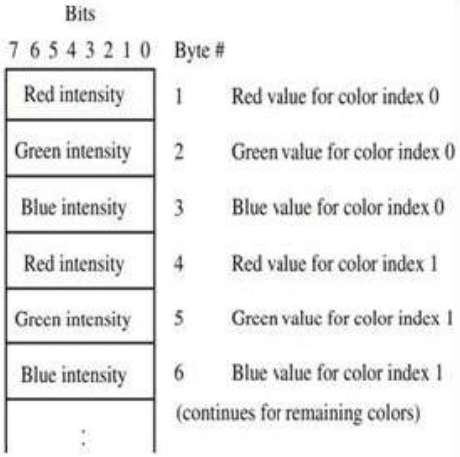
- Graphics Interchange Format (GIF) devised by the UNISYS Corp. and CompuServe, initially for transmitting graphical images over phone lines via modems.
- One of the simplest is the 8-bit GIF format, and we study it because it is easily understood, and also because of its historical connection to the WWW and HTML markup language as the first image
- Type recognized by net browsers.
- Limited to only 8-bit (256) colour images, suitable for images with few distinctive colours (e.g., graphics, drawing)
- GIF89a: supports simple animation, transparency index etc.



GIF file format



Screen descriptor



Color map

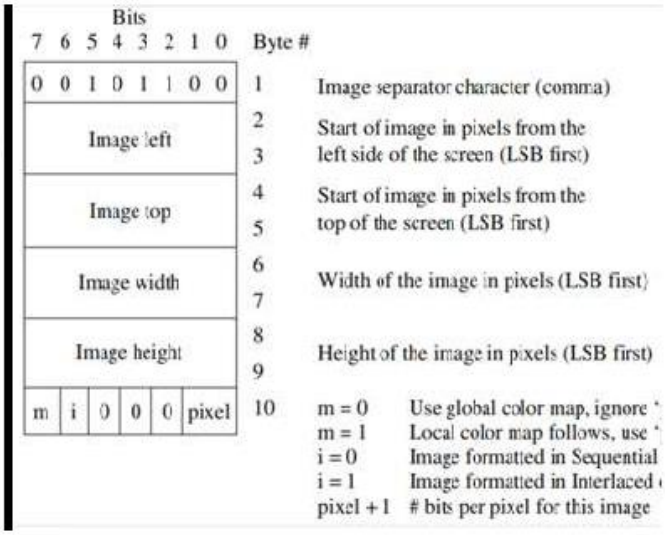


Image descriptor

2- JPEG Standard

- A standard for photographic image compression created by the Joint Photographic Experts Group
- Takes advantage of limitations in the human vision system to achieve high rates of compression.
- Lossy compression which allows user to set the desired level of quality/compression.

3- TIFF

- Tagged Image File Format stores many deferent types of images (e.g., bit-map,greyscale, 8-bit & 24-bit RGB, etc.).
- Developed by the Aldus Corp. in the 1980's and later supported by the Microsoft
- TIFF is a typically lossless format.
- It does not provide any major advantages over JPEG and is not as user-controllable it appears to be declining in popularity.

4- BMP

- BitMap (BMP) is the major system standard graphics file format for Microsoft
- Windows.
- used in Microsoft Paint and other programs. It makes use of run-length encoding compression and can fairly efficiently store 24-bit bitmap images.
- Note, however, that BMP has many different modes, including uncompressed 24-bit images.

5- PNG

PNG meant to supersede GIF standard

Features of PNG:

- Support up to 48 bits per pixel - more accurate colors
- Support description of gamma-correction and alpha-channel for controls such as transparency
- Support progress display through 8×8 blocks.