Images

Chapter 4

Images

Images are a media type displayed as visual information. They can be drawings, paintings or photographs.

Images are used to create interest and provide information. Photographs and other types of graphical data are designed specifically for display.

An image on a screen is made up of dots called *pixels*.

A pixel is the smallest part of the screen that can be controlled by the computer or other device.

The total number of pixels on a screen is called its *resolution*.

Graphics/Image Data Types

Image Format describes how data related to the image will be stored. Data can be stored in compressed, Uncompressed, or vector format. Each format of the image has a different advantage and disadvantage. Image types such as TIFF are good for printing while JPG or PNG, are best for the web.

- Table 3.1 shows a list of file formats used in the popular product Adobe Premiere.

Table 3.1 Some popular Adobe Premiere file formats

Image	Audio	Video
BMP, DIB,	AIFF, AAC,	AVI, DV,
GIF, HEIF,	AC3, BWF,	FLV, HEVC,
JPG, PICT,	MP3, M4A,	M4V, MOV, MP4,
PNG, PSD,	WAV, WMA	MPG, MTS, MXF,
TGA, TIF		SWF, WMV

➤ **TIFF(.tif, .tiff):** Tagged Image File Format this format store image data without losing any data. It does not perform any compression on images, and a high-quality image is obtained but the size of the image is also large, which is good for printing, and professional printing. TIFF files can have a bit depth of either 16-bits per channel or 8-bits per channel.

➤ **JPEG (.jpg, .jpeg):** Joint Photographic Experts Group is a loss-prone (lossy) format in which data is lost to reduce the size of the image. Due to compression, some data is lost but that loss is very less. It is a very common format and is good for digital cameras, nonprofessional prints, E-Mail, Powerpoint, etc., making it ideal for web use.

JPEG is standardized as an 8-bit image file. This means that each color channel (R, G and B) of a pixel has 8-bits of data allocated to reproduce color (8 bits + 8 bits +8 bits = 24 bits).

- **GIF (.gif):** GIF or Graphics Interchange Format files are used for web graphics. It supports animations and are limited to only 256 colors, which can allow for transparency. GIF files are typically small in size. It is highly compressed image, which uses the LZW compression algorithm that does not degrade the image quality.

- **PNG (.png):** PNG or Portable Network Graphics files are a lossless image format , meaning that the compressed file can reconstruct the source image exactly. It was designed to replace gif format as gif supported 256 colors. PNG offers a range of color depths, from 1-bit to 48-bit. , and supports different levels of transparency.

- **Bitmap (.bmp)** Bit Map Image file is developed by Microsoft for windows. It is same as TIFF due to lossless, no compression property.

  BMP supports a range of color depths, from 1-bit (black and white) to 24-bit (true color).

  BMP files are larger than JPEGs and are uncompressed; that is, they maintain all the data ofthe original image in exchange for large file size

➡ **RAW Image Files (.raw, .cr2, .nef, .orf, .sr2)** These Files are unprocessed and created by a camera or scanner. These images are the equivalent of a digital negative, meaning that they hold a lot of image information. These images need to be processed in an. It saves metadata and is used for photography.

➡ **PSD:** stands for **Photoshop Document**, which is an image format that supports layers of graphics in a single file. It is mostly used for working with layers of graphics. Unlike other image formats, it can hold layers with masks, transparency, text, alpha channels and spot colors.

Image types

1-Bit Images

- Images consist of pixels (picture elements in digital images).

- A 1-bit image (also called binary image) consists of on and off bits only and thus is the simplest type of image.

- Each pixel is stored as a single bit (0 or 1)

- It is also sometimes called a *1-bit monochrome (called Lena image by scientists)* image since it contains no color. See Figure in next slide.

- Monochrome

- 1-bit images can be satisfactory for pictures containing only simple graphics and text.

- fax machines use 1-bit data, so in fact 1-bit images are still important.

Monochrome 1-bit Lena image

A 640×480 monochrome image requires 38.4 kB of storage

8-Bit Gray-Level Images

- 8-bit image is one for which each pixel has a *gray value* between 0 and 255.

- Each pixel is represented by a single byte.

- The entire image can be thought of as a two-dimensional array of pixel values referred to as a *bitmap*.

- *Image resolution* refers to the number of pixels in a digital image (higher resolution always yields better quality but increases size)

Grayscale image of Lena

640×480 grayscale image requires 300kB of storage

24-Bit Color Images

➡ 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; which increases storage size.

➡ a 640 × 480 24-bit color image would require 921.6 kB of storage. (without any compression applied)

➡ Compression is used to decrease the image size by simply grouping pixels effectively. (chapter 7).

24-bit color image forestfire.bmp

Microsoft Windows BMP format

Higher Bit-Depth Images

- In some fields such as medicine (security cameras, satellite imaging) more accurate images are required to see the patient's liver, for example.

- To get such images, special cameras that view more than just 3 colors (RGB) are used.

- Such images are called *multispectral* (more than three colors) or *hyperspectral* (224 colors for satellite imaging).

8-Bit Color Images

- reasonably accurate color images can be obtained by *quantizing* the color information to collapse it.

- Color quantizing example: reducing the number of colors required to represent a digital image makes it possible to reduce its file size.

- 8-bit color image (so-called 256 colors. Why?) files use the concept of a *lookup table (LUT)* to store color information.

- For example,:
  - if exactly 23 pixels have RGB values (45, 200, 91)
  - then store the value 23 in a three-dimensional array, at the element indexed by the index values [45, 200, 91].

- This data structure is called a *color histogram.*

- *color histogram:* is a very useful tool for image transformation and manipulation in Image Processing.

Notice that the difference between Fig. 3.5a, the 24-bit image, and Fig. 3.7, the 8-bit image, is reasonably small.

Fig. 3.5a, the 24-bit image

Fig. 3.7, the 8-bit image

Another example for difference between Fig. 3.5a, the 24-bit image, and Fig. 3.7, the 8-bit image, is reasonably small.

Fig. 3.5a, the 24-bit image

Fig. 3.7, the 8-bit image

8-Bit Color Images

- Note the great savings in space for 8-bit images over 24-bit ones:

- a 640 × 480 8-bit color image requires only 300 kB of storage,

- compared to 921.6 kB for a color image (again, without any compression applied).

Color Lookup Tables

- The LUT is often called a *palette*.

- The idea is to store only the index, or code value, for each pixel.

- if a pixel stores, say, the value 25 (Figure 3.8), the meaning is to go to row 25 in a color lookup table (LUT).