3.2. Graphic/Image File Formats

Graphic/Image Data Structures
Standard System Independent Formats
Specific System Dependent Formats

This section introduces some of the most common graphics and image file formats. Some of them are restricted to particular hardware/operating system platforms, others are *cross-platform* independent formats. While not all formats are cross-platform, there are conversion applications that will recognize and translate formats from other systems.

Most image formats incorporate some variation of a *compression* technique due to the large storage size of image files. Compression techniques can be classified into either **lossless** or **lossy**. We will study various video and audio compression techniques in Chapter 4.

3.2.1. Graphic/Image Data Structures

- **Pixels** -- picture elements in digital images
- **Image Resolution** -- number of pixels in a digital image
  (Higher resolution always yields better quality.)
- **Bit-Map** -- a representation for the graphic/image data in the same manner as they are stored in video memory.

Monochrome Image

Example of a Monochrome Bit-map Image

- Each pixel is stored as a single bit (0 or 1)
- A 640 x 480 monochrome image requires 37.5 KB of storage.
- *Dithering* is often used for displaying monochrome images

Gray-scale Images

Example of a Gray-scale Bit-map Image

- Each pixel is usually stored as a byte (value between 0 to 255)
- A 640 x 480 grayscale image requires over 300 KB of storage.

24-bit Color Images

Example of 24-Bit Color Image

- Each pixel is represented by three bytes (e.g., RGB)
- Supports 256 x 256 x 256 possible combined colors (16,777,216)
- A 640 x 480 24-bit color image would require 921.6 KB of storage
- Many 24-bit color images are stored as 32-bit images, the extra byte of data for each pixel is used to store an *alpha* value representing special effect information

8-bit Color Images

Example of 8-Bit Color Image

- One byte for each pixel
- Supports 256 out of the millions colors possible, acceptable color quality
- Requires Color Look-Up Tables (LUTs)
- A 640 x 480 8-bit color image requires 307.2 KB of storage (the same as 8-bit grayscale)

3.2.2. Standard System Independent Formats

The following brief format descriptions are the most commonly used formats. Follow some of the document links for more descriptions.

GIF (gif87a, GIF89a)

- Graphics Interchange Format (GIF) devised by the UNISYS Corp. and Compuserve, initially for transmitting graphical images over phone lines via modems
- Uses the Lempel-Ziv Welch algorithm (a form of Huffman Coding), modified slightly for image scan line packets (line grouping of pixels)
- Limited to only 8-bit (256) color images, suitable for images with few distinctive colors (e.g., graphics drawing)
- Supports *interlacing*
- GIF89a supports simple *animation*

(Graphics Control Extension has control over *delay time*, *transparent index*, etc. Software such as Coral Draw will allow access and editing of GIF images.)

JPEG

- A standard for photographic image compression created by the Joint Photographics 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
- Detailed discussions in Chapter 4.

TIFF

- Tagged Image File Format (TIFF), stores many different types of images (e.g., monochrome, grayscale, 8-bit & 24-bit RGB, etc.) --> tagged
- Developed by the Aldus Corp. in the 1980's and later supported by Microsoft.
- TIFF is a lossless format (when not utilizing the new JPEG tag which allows for JPEG compression).
- It does not provide any major advantages over JPEG and is not as user-controllable it appears to be declining in popularity.

Graphics Animation Files

- FLC -- main animation or moving picture file format, originally created by Animation Pro
- FLI -- similar to FLC
- GL -- better quality moving pictures, usually large file sizes

Postscript/Encapsulated Postscript

- A typesetting language which includes text as well as vector/structured graphics and bit-mapped images
- Used in several popular graphics programs (Illustrator, FreeHand)
- Does not provide compression, files are often large

3.2.3. System Dependent Formats

Many graphical/imaging applications create their own file format particular to the systems they are executed upon. The following are a few popular system dependent formats:

Microsoft Windows: BMP

- A system standard graphics file format for Microsoft Windows
- Used in PC Paintbrush and other programs
- It is capable of storing 24-bit bitmap images

Macintosh: PAINT and PICT

- PAINT was originally used in MacPaint program, initially only for 1-bit monochrome images.
- PICT format is used in MacDraw (a vector based drawing program) for storing structured graphics

X-windows: XBM

- Primary graphics format for the X Window system
- Supports 24-bit color bitmap
- Many public domain graphic editors, e.g., *xv*
- Used in X Windows for storing icons, pixmaps, backdrops, etc.

Further Exploration

- A new graphics file format -- PNG (Portable Network Graphics)
- Current PNG References
- Animated illustration of the PNG 2-D interlacing

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