Week 3: Image File Formats

DIGITAL ASSET DEVELOPMENT

Contents

- Vector and bitmap graphics
- Image formats
  - GIF
  - JPEG
  - PNG

Vector Graphics

- Previous material all referred to bitmap / raster graphics
  - Digital images defined as a grid or array of pixel values
- We can also define an image as a set of vector objects
  - Circles, rectangles, stars, polygons,…
  - Lines, curves, fills, patterns,…
  - Text and other symbols

Defining Vector Objects

- In a bitmap image a circle is defined by a (large) collection of pixel values
  - Circle 50 pixels across = 2500 pixel values
- A vector circle is defined by:
  - The location of its centre point
  - Its radius
  - Stroke and fill colours
  - Its “height” relative to the other objects in the image (is it in front of or behind them)

Properties of Vector Graphics

- Vectors have some major advantages:
  - File size: vector objects can be described using very little data
  - Rescaling: any vector object can be resized without any loss of quality
  - Non-destructive editing is much easier
- Thus, vector graphics can be efficient for conveying drawn graphics
- However, they can't efficiently describe real-world pictures

Vector Graphics Software

- Drawing packages like Adobe Illustrator use vector data (as do CAD tools)
- Flash is primarily vector-based
- Photoshop started out with minimal vector graphics functionality
  - Current versions have sophisticated vector tools that are also integral to bitmap editing
  - Fireworks is another package that combines bitmap and vector functionality

Media File Formats

- A key part of this module is understanding file formats for digital assets
- We have a wide choice of formats for most digital media types
- Need to be aware of their strengths and weaknesses
  - What forms of picture/sound/video are they most suited to
  - Which applications and workflows do they work well with

Format Types

- We can distinguish between formats for authoring and distribution
  - Authoring formats are those used in the development process
  - Distribution formats are used for delivery to the end user (or the next stage in a pipeline)
- For example, Flash's authoring format is FLA and its distribution format is SWF
  - Photoshop PSD is primarily for authoring
  - Word DOC format is used as both types

Useful Format Properties

- A useful digital media distribution format should have:
  - An efficient compression algorithm for fast download and easy storage
  - Readability across a wide range of systems and software packages
  - Flexibility and extensibility, allowing for advances in software and hardware
- As an example, we will look at formats for digital image data distribution

Image File Formats

- Most used authoring format is undoubtedly PSD due to prevalence of Photoshop
  - Fireworks uses PNG (Portable Network Graphics) as a native authoring format
- The most common distribution formats are GIF, JPEG and PNG
  - We will look at these in some detail
- many more specialist formats exist:
  - TIFF (Tagged Image File Format) now used mainly in desktop publishing
  - Targa is used in 3D, partly for historical reasons

The GIF Format

- Original GIF (Graphical Interchange Format) standard introduced in 1987
- GIF89a specification introduced transparency and animation
- GIF files were very commonly used for web graphics, icons and animations
  - Some issues with copyright of the data format
  - GIF is now an open standard and can be freely used

GIF Encoding

- GIF uses “Lempel-Ziv-Welch” (LZW) compression algorithm
- This is a lossless process
  - Image content remains identical to the original
- This form of compression is typically used for 8-bit image data
- Effective compression relies on repeated sequences of pixel values
  - This affects the kinds of images for which GIF compression will work well

LZW Compression

- Basic compression procedure:
  - Set up table of code values
  - Scan through pixels – whenever a new sequence appears, assign it a new code
  - Output the stream of coded values
- To uncompress the image:
  - Convert stream of codes into data values
  - Code/value table is automatically generated during decompression
  - This is the clever bit!

LZW Characteristics

- For this process to be effective, an image must have many repeated sequences
- This is likely for low bit depths, as the set of possible values is small
  - Typical examples: diagrams, cartoons
  - GIF format allows a bit-depth of up to 8
- The system also saves file space by not having to store the table of code values

JPEG Format

- Short for Joint Photographic Expert Group (usually shortened to JPG)
  - Defined as an agreed web standard for distribution of photographic images
  - 24-bit format
- JPEG uses lossy compression
  - Some data loss during the process
  - Trade-off between file size and quality
- JPEG uses transform encoding method

Transform Encoding

- Divide the image into subregions of (usually) 8x8 pixels
- Each subregion is therefore wholly defined by its 64 pixel values
- Then we carry out a mathematical transform (the tricky bit)
  - Subregion is now defined by 64 “transform coefficients”
  - These are numbers describing how colour or brightness varies across the subregion

Transform Encoding (2)

- Our sets of 64 coefficients for each subregion can have any value
  - Thus they are not restricted to range 0-255
- We then quantise the coefficients into a fixed range (rather like digital sampling)
  - This “throws away” some image information
  - The amount of information thrown away determines resultant file size and quality
  - Finally, we store the quantised coefficients as a JPEG file

Impact of Transform Encoding

- The quantisation process is not reversible → lossy
- Very high compression makes an image appear "blocky" [see right]
- These blocks correspond to the 8x8 pixel subregions
- We also get artefacts at hard edges in a scene

GIF vs JPG

- The different compression processes suit different types of image
- GIF:
  - Good for scenes containing hard edges and few colours (eg. diagrams, cartoons)
  - Poor for full colour scenes
- JPG:
  - Good for photorealistic, full colour scenes
  - Bad for simple scenes containing hard lines and edges

PNG Format

- Portable Network Graphics (“ping”)
  - for geeks, “PNG’s Not GIF”
- Newer format, originally intended to replace GIF
- Flexible format with a great many useful features
- Doesn’t support animation (unlike GIF)
- Not as universally supported as GIF or JPG, but still very widespread

PNG Features

- PNG format can use colour depths of up to 48-bit (three 16-bit channels)
- Can also handle an indexed 256-colour palette (like GIF)
  - Known as PNG-8 format in some applications
- Also has different modes for handling transparency
  - Single transparency value (as with GIF)
  - 8 or 16-bit alpha channel

When PNG is Useful

- For many types of image, PNG gives no benefit over GIF or JPG
  - GIF is fine for low colour depth images
  - JPG gives good compression for photos
- PNG is useful where:
  - The image combines photorealism and hard edges (eg. text overlaid on a photo)
  - Alpha channels are required
  - Image will be saved many times (hence its use as an authoring format in Fireworks)