CSE 3200 Computer Graphics & Image Processing
– Digital Imaging

Presenter: Girendra Persaud
University of Guyana

Outline

- Defining Digital/Image
- 2D Image
  - Vector Graphics
  - Raster Graphics
  - File Formats
  - File Size Comparison
- 3D Image
- Conclusion
- Questions
- Review Questions

Digital Image Definition

- What is the meaning of “digital”?
  - “Digital information is represented using a series of ones and zeros.” (on and off electrical signals)
- What is the definition of “Image”?
  - As related to Computer Graphics: “A representation of a scene, object or a single frame of a simulation or video”

Digital Image Definition

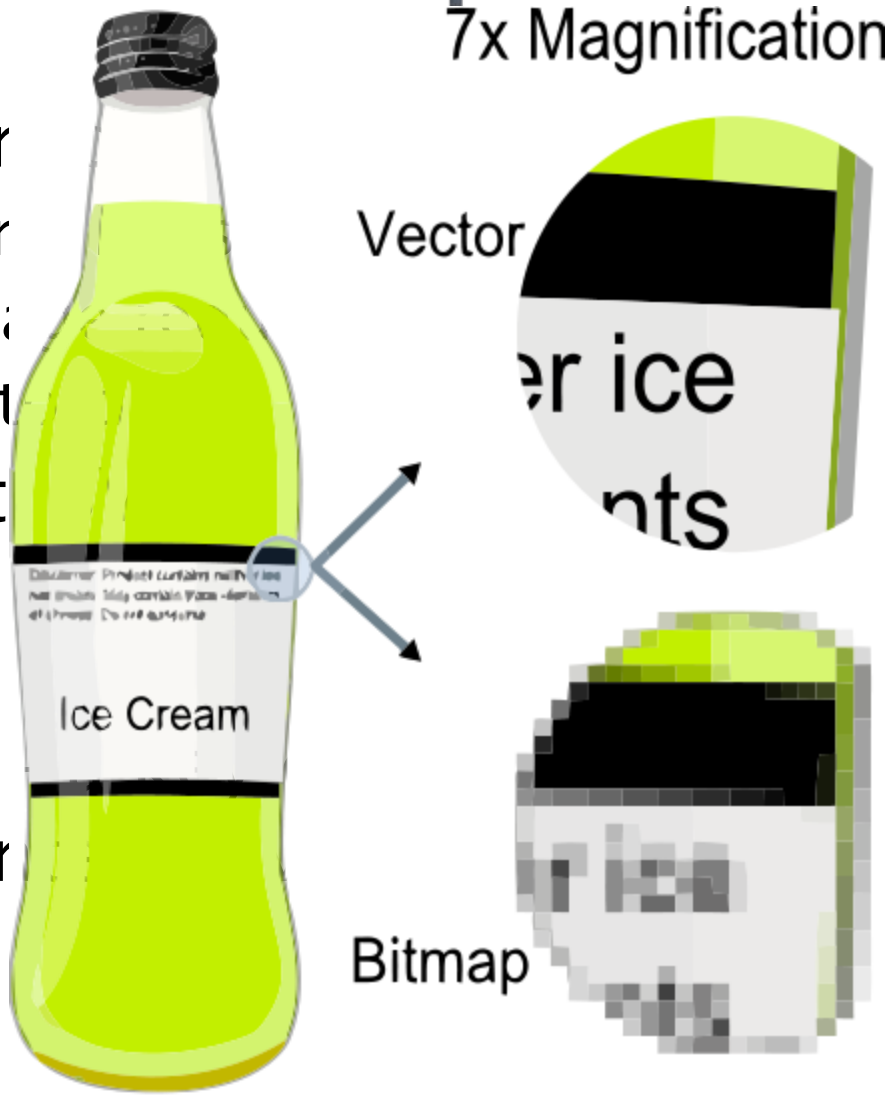
- Digital Image?
  - A digital representation of a picture as a finite set of values/specifications.
  - Digital Image files are either made up of _____ or _____ _____.
  - Pixels or vector data….

2D Image

- photographs, drawings, videos*, simulations** (*,** the frames…)
- Image that gives one view (of a scene) restricted to the height and width of the representation
- 2D freedom?
  - Zoom in/out
  - Rotate/change orientation
  - Resize/crop
  - Skew/alter aspect ratio

2D Image – Vector Graphics

- Geometrically Defir
  - Basic Primitives: Poir
  - Relatively lower stora
  - Zoom In without dist
- File storage format
  - Textual
  - Gzip compression
- Scripting Potential
  web applications/ir



2D Image – Raster Graphics

- What is raster?
  - "A *raster* is a grid of x and y coordinates on a display space."
- Raster Graphics:
  - "Raster graphics are digital images created or captured … as a set of samples of a given space". Each sample space is represented by a pixel.
- Storage Size: depends on
  - Color depth
  - Image resolution
  - Compression
- Sometimes referred to a Bit Mapped Image

Raster Graphics – Con't

- File formats: GIF, JPEG, PNG, BMP, TIFF etc.
- Why all these formats?
  - Compression: reducing the size of the digital image file by applying one of two algorithms.
- Lossy Compression:
  - Takes advantage of the limitations of the human eyes
- Lossless Compression:
  - details are preserved

Compression?

- **Image compression** is an application of data **compression** that encodes the original **image** with few bits. The objective of **image compression** is to reduce the redundancy of the **image** and to store or transmit data in an efficient form.

Source:
http://disp.ee.ntu.edu.tw/meeting/%E7%B6%AD%E6%AF%85/An%20Introduction%20to%20Image%20Compression/An%20introduction%20to%20Image%20Compression.pdf

Case – Google

- At Google, we are constantly looking at ways to make web pages load faster. One way to do this is by making web images smaller. Images comprise up to 60%–65% of bytes on most web pages and page size is a major factor in total rendering time. Page size is especially important for mobile devices, where smaller images save both bandwidth and battery life.
- WebP is a new image format developed by Google and supported in Chrome, Opera and Android that is optimized to enable faster and smaller images on the Web. WebP images are about 30% smaller in size compared to PNG and JPEG images at equivalent visual quality. In addition, the WebP image format has feature parity with other formats as well. It supports:

Case Google con't

- WebP
  - **Lossy compression**: The lossy compression is based on VP8 key frame encoding. VP8 is a video compression format created by On2 Technologies as a successor to the VP6 and VP7 formats.
  - **Lossless compression**: The lossless compression format is developed by the WebP team.
  - **Transparency**: 8-bit alpha channel is useful for graphical images. The Alpha channel can be used along with lossy RGB, a feature that's currently not available with any other format.
  - **Animation**: It supports true-color animated images.
  - **Metadata**: It may have EXIF and XMP metadata (used by cameras, for example).
  - **Color Profile**: It may have an embedded ICC profile.

Raster Graphics – Con't

- GIF: Graphic Interchange Format
  - Limited to 8-bit palette (256 colors)
  - Suitable for images with few colors (shapes, logos, CAD like images)
  - Support animations – frame switching
  - Lossless compression
    - Effective when a large area has the same color
    - Ineffective for detailed image or dithered image
  - Color format – index color mode

Raster Graphics – Con't

- JPEG: Joint Photographic Experts Group
  - Common format for digital camera image storage, internet
  - Support 8 bits per color (RGB color mode) – 24 bits "true" color information
  - Lossy Compression
    - variable quality
    - Can suffer generational degradation when repeatedly edited and saved
- JPEG compression is also used for Adobe PDF files.

Raster Graphics – Con't

- PNG: Portable Network Graphics
  - Free and open-source successor of GIF
  - Support 24-bit – true color, 16,777,216 possible colors, RGB color mode
  - Lossless Compression
    - Excel with images with large areas of uniform color
- Can support transparency – popular with presentational web pages
- Allows early preview even when only a small percentage of the image file is loaded (equivalent JPEG to progressive option – PhotShop)

Raster Graphics – Con't

- BMP: Windows Bitmap
  - not compressed (large storage size)
  - Wide acceptance
  - Simplicity

- TIFF: Tagged Image File Format
  - 8 or 16 bits per color – RGB color mode
  - Lossy and lossless compression (black & white Images)
  - File standard in the printing industry (CYMK)

New Formats – WebP

- WebP is a new image format that provides lossless and lossy compression for images on the web. WebP lossless images are 26% smaller in size compared to PNGs.

New Formats – BPG

- BPG (Better Portable Graphics)
- One of the big advantages BPG has over JPEG is its ability to deliver similar image quality as JPEG at about half the file size.

New Formats – BPG

BPG (left) and JPEG (right) of a photo compressed to a file size of roughly 5872 bytes.

Source: http://petapixel.com/2014/12/13/bpg-new-image-format-wants-replace-jpeg-equal-quality-half-size/

3D Scene File Formats

- 3D offer the additional freedom of “views”
- Lighting effects, shadow, texture, reflection and other calculations

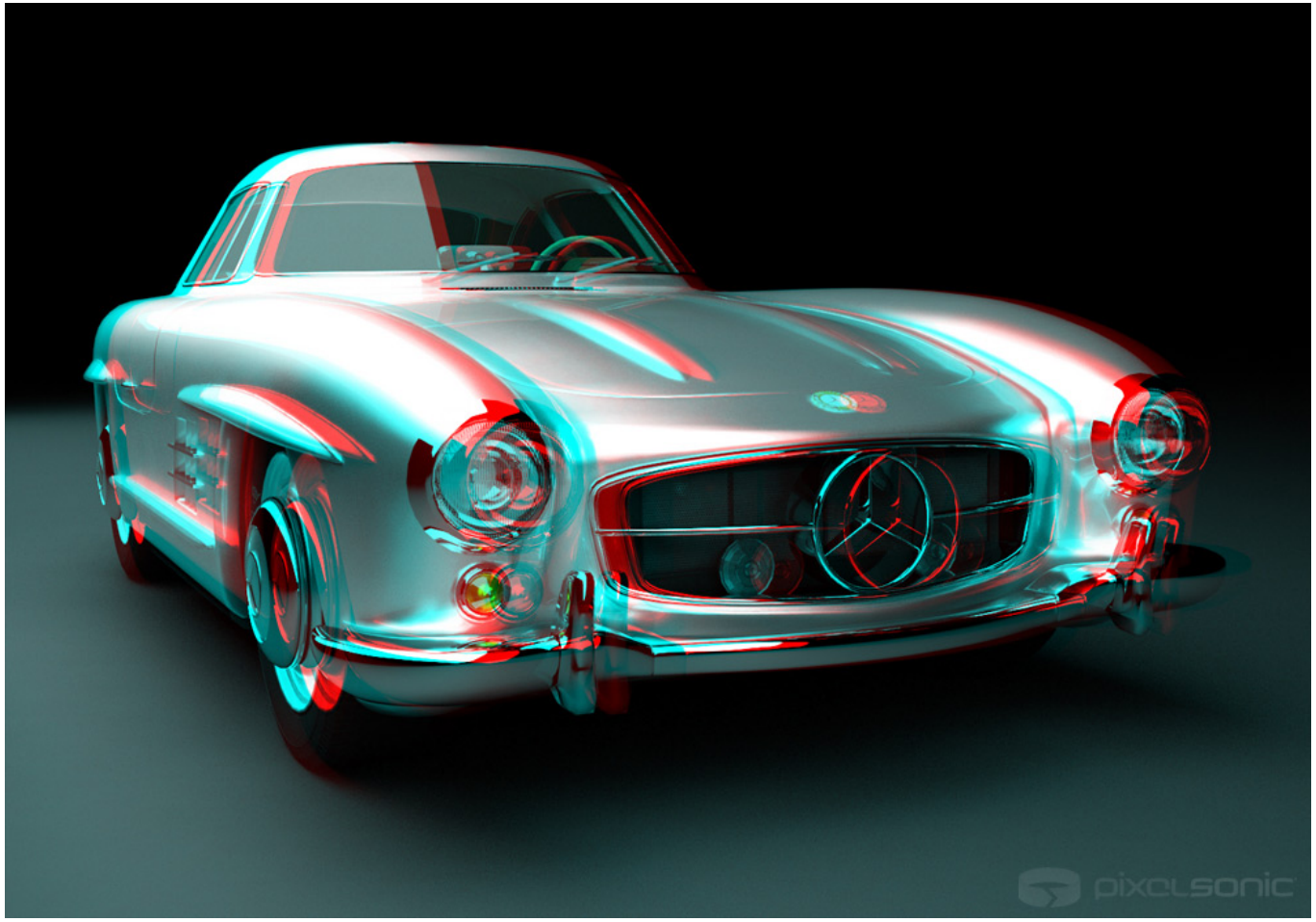
- See: http://www.ibrtses.com/opengl/fileformats3d.html

3D Image Formats

- 3D images are either

- Vector-based (true 3D, freedom of views)
- OR
- Stereoscopic (emulated, fixed views)

Stereo Image



Review

- Defining Digital/Image
- 2D Image
  - Vector Graphics
  - Raster Graphics
  - File Formats
  - File Size Comparison
- 3D Scenes

Questions?

Review Questions/discussions

- What is vector-based graphics suitable for?
- If you are taking a class photo – what format will you use to store the image file? Why?
- Why does JPEG suffer from generational degradation during repeated editing and saving?

References

- Digital Image Definition: http://www.techterms.com/definition/digital
- Raster: cpc.cadmus.com/da/glossary.jsp
- 3D File Formats: http://www.ibrtses.com/opengl/fileformats3d.html
- http://www.archives.gov/applied-research/ncsa/8-an-overview-of-3d-data-content-file-formats-and-viewers.pdf
- https://en.wikipedia.org/wiki/VP8
- https://developers.google.com/speed/webp/docs/compression