CSc 461/561 Multimedia Systems Image Representation

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Feedback on A0

live-streamed location compress information games video/audio video video video/audio video/audio about interests loss frame user image work high-res multicast VOIP federation Ideally Mumble encoded files encryption based music between know glad same level moving learning fps MB flash works editing browser gifs media USES want HDR interest twitch apps online MM example HTML well instead compression multimedia hands well instead sent ie like learn youtube audio across netwo interested interested audio/music conferencing cloud encoding Skype communication Cameraltaking interesting more compressed real-time format

Light is also a wave

- What we see
 - objects either emit lights
 - or reflect lights
- We indeed see objects of different colors
 - different wavelengths
 - visible light: 400 700nm
 - white is *more* than a color



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• violet, indigo, blue, cyan, green, yellow, orange, red

* prism and rainbow; speed of light (299,792,458m/s in vacuum)

Digitizing what we see

- E.g., scanning a picture: images
 - a 2-dimension array of pixels
 - a pixel showing a certain color (picture element)
 - dpi (dots per inch): e.g., 600 dpi
 - each pixel is represented by a (few) number(s)
 - similar to digitizing audio signal
 - but often by a few numbers with <u>different</u> meanings
- E.g., drawing a picture: graphics

* one data format might be better than another in one case



Image is a 2-d array of pixels

- Image attributes
 - image resolution: array size, e.g., 640x480
 - pixel depth: bits per pixel, e.g., 8-bit
- Display attributes
 - display resolution: e.g., 1024x768
 - dot pitch: e.g., .28mm



- how to keep "aspect ratio"

* 20"? 16:9 vs 4:3? who got the most of pixels?

Pixel is represented by bits

- Black-white (monochrome): 1-bit
- Grayscale: e.g., 8-bit
- (true) color
 - e.g., 8-bit each for RGB; i.e., 24-bit total
 - 32-bit total w/ alpha channel
- (pseudo) color
 - e.g., 8-bit in total for (pseudo) RGB
- with a lookup table
- * transparency







Color space: RGB

- Red, Green and Blue
 - human eyes have three types of "light sensors"
 - sensitive to red, green and blue, respectively
- Primary color
 - mixing RGB to get other colors
 - additive color
 - used in CRT/LCD etc



CMY and CMYK

- Cyan, Magenta and Yellow
 - primary color in CMY space
 - widely used for printing (paper reflecting color)
 - mixing CMY to get other colors
 - subtractive color
 - Cyan+Magenta+Yellow=Black
 - Black is easier/better to get otherwise
 - CMYK

RGB vs CMY

- RGB and CMY are related
 Let R/G/B in [0,1]
 - Let C/M/Y in [0,1]
 - R+C=1
 - G+M=1
 - B+Y=1



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YUV

- Widely used in black-white/color TV
- Y: luminance
 - brightness (black-white TV)
- UV: chrominance
 - color difference w/ reference
 - (color TV)
- Further humans see

- brightness and color differently ^{1/13/15}

RGB vs YUV

- RGB => YUV -Y = 0.299R + 0.587G + 0.114B -U = 0.492 (B - Y) = -0.147R - 0.289G + 0.436B -V = 0.877(R - Y)= 0.615R - 0.515G - 0.100B
- Let R/G/B in [0,1]
 - Y in [0,1], U in [-0.436,0.436], V in [-0.615, 0.615]

* know how to do the transform ^{CSc}

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RGB vs YUV





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Gamma correction

• Non-linearity in display devices $R \rightarrow R' = R^{1/\gamma} \Rightarrow (R')^{\gamma} \rightarrow R$



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Gamma correction examples



This lecture

- Image representation
 - image: resolution and depth
 - color space and transform
 - gamma correction
- Explore further
 - more color spaces [Li&Drew 4.3.3]

Next lecture

- Multimedia representation
 - video [Ref: Li&Drew Chap 5]
 - types of video signal [5.1]
 - analog video (e.g., TV) [5.2]
 - digital video [5.3]