Modern Display Technologies

Display
- An output device for presentation of visual information
- We will discuss video displays
  - Used for receiving moving images, either monochromatic (black and white) or color, usually accompanied by sound in our case

Basic Display Technologies

Pixel
- Short for picture element
- It is the smallest item of information in an image
- Pixels are normally arranged in a 2-dimensional grid, and are often represented using dots, squares, or rectangles
The color of each pixel is determined by the amount of red, green, and blue light.

- Red 255, Green 255, and Blue 255 = White
- So 256 possible colors
  - In RGB 0 counts as a color hence 0-255
  - Red 0, Green 0, and Blue 0 = Black
  - All the lights are off
  - Various settings in between produce the other 16.7 million colors

RGB Color Space 16.7 million colors (256 x 256 x 256)
Additive vs. Subtractive Color

- **Color Mixing**
  - The mixing of lights - additive
    - If one takes two differently colored beams of light and projects them on to a screen, the mixing of these lights occurs according to the principle of additive color mixing
  - The mixing of pigments - subtractive
    - If one mixes two differently colored paints they mix according to the principle of subtractive color mixing
For example:
- Blue light + Yellow light = White Light
- Blue Paint + Yellow Paint = Green Paint
- The reason behind CMYK for printing and RGB for lights and displays

Magazine photograph printed in CMYK
Video Display Types

- Most Commonly
  - CRT – Cathode Ray Tube
  - Plasma
  - LCD – Liquid Crystal Display
  - DLP – Digital Light Processing
  - LED – Light Emitting Diodes
  - Projection Technologies

Display Pixel Examples

- In class GIANT PIXEL examples
  - CRT
  - LCD
  - Plasma
  - DLP Projection
    - Digital Micromirror
    - LCD Projection
CRT

- A vacuum tube containing an electron gun (a source of electrons) and a fluorescent screen, with internal or external means to accelerate and deflect the electron beam, used to create images in the form of light emitted from the phosphors on the screen.

Liquid Crystal Display

- Displays that use LCD technology to produce images:
  - Benefits of LCD technology include lower weight and reduced power requirements when compared to other display types.
  - LCD television screens can often also be used as computer monitors.
  - LCD TV is sometimes referred to as a “transmissive” display because light isn’t created by the liquid crystals themselves.
Plasma

- Type of flat panel display common to large TV displays (37in. and up usually)
- Many tiny cells between two panels of glass hold an inert mixture of noble gases
  - The gas in the cells is electrically turned into a plasma which then excites colored phosphors to emit light
  - This is considered “emissive” technology because light is emitted

Plasma

Light Emitting Diode

- LED a light source that emits light when an electrical current is applied to it
- A RGB cluster creates a virtual pixel
- Used for giant outdoor-type displays
**Display Projectors**

- Takes a video signal and projects the corresponding image on a projection screen using a lens system
- Can be rear or front projection system

**Digital Light Processing**

- In DLP the image is created by microscopically small mirrors laid out in a matrix on a semiconductor chip, known as a Digital Micromirror Device (DMD)
- Each mirror represents one or more pixels in the projected image
- Used in front and rear projectors

**Digital Light Processing**

- Single Chip Projector
  - Colors are either produced by placing a color wheel between the lamp and the DLP chip or by using individual light sources to produce the primary colors such as RGB - LEDs
  - Can have a “rainbow effect”
- Three Chip Projector
  - Projector uses a prism to split light from the lamp, and each primary color of light is then routed to its own DLP chip, then recombined and routed out through the lens
Plasma vs. LCD

- Screen size
  - Plasma = 42 - 72+
  - LCD = 5 - 65+
- Power Consumption
  - Plasma slightly more than LCD
- Weight
  - Plasma weighs slightly more than LCD
- Off angle viewing
  - Plasma is better at all angles vs. LCD
- Image Retention (Burn In)
  - And definite concern with Plasma not with LCD
  - LCD thus often better for gaming with constant screens
- Black Level (Contrast Ratio)
  - Often better on Plasma because all off is true black vs. grey with LCD