

Handouts: Raster Graphics Hardware

Raster Graphics Hardware



Questions?

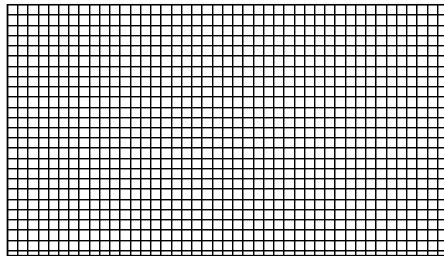


- A1?
- Accounts?

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Basic Definitions

- Raster: A rectangular array of points or dots.
- Pixel (Pel): One dot or picture element of the raster
- Scan Line: A row of pixels



Example Raster Graphics Architecture

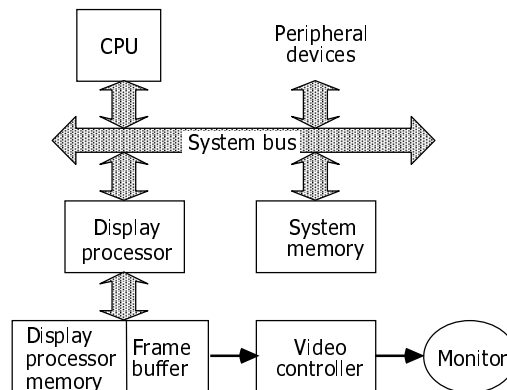
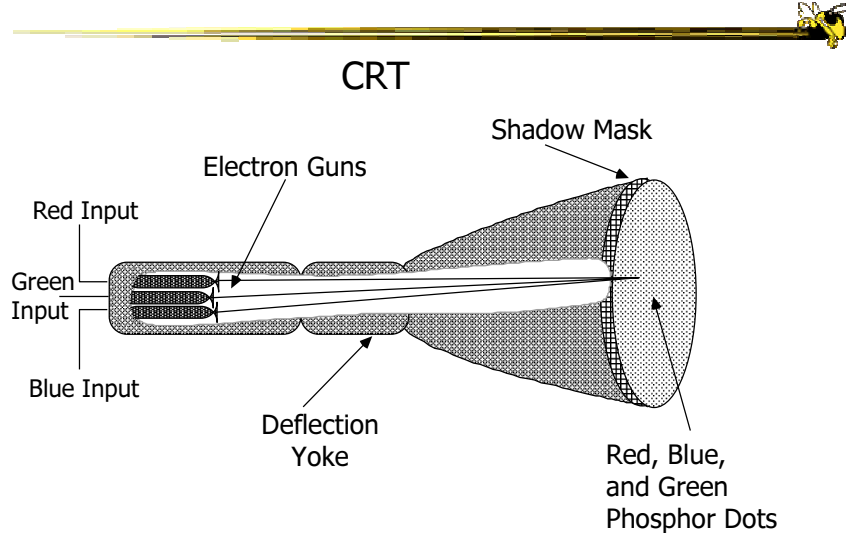


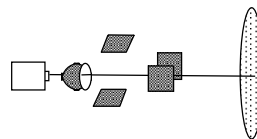
Fig. 4.22 Raster system architecture with a display processor.
(from Computer Graphics: Principles and Practice.)

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CRT Monitor



Electron Gun

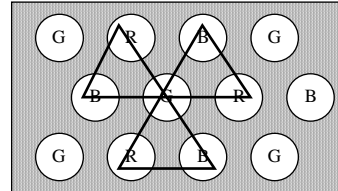


- Stream of electrons directed to front
 - Num electrons controls brightness
- Phosphor, glows briefly
- Gaussian

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Color CRT

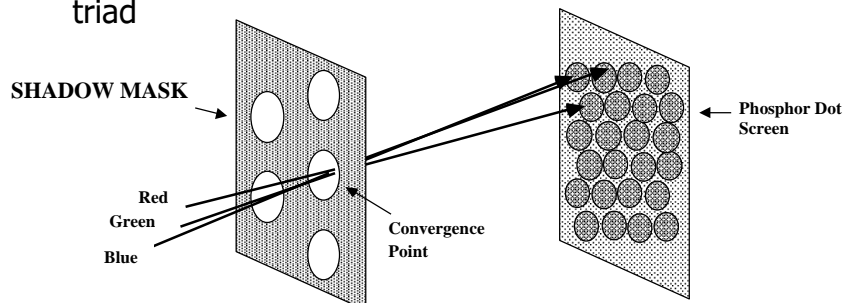
- RGB electron guns
- Screen coated with phosphor pattern



- Fluorescence
- Phosphorescence
- Persistence

Shadow Mask

- Phosphors arranged in triads
- Each triad has one R/G/B phosphor dot
- Typically 2.3 to 2.5 triads per pixel
- Shadow mask has one small hole for each phosphor triad



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Aperture Grill

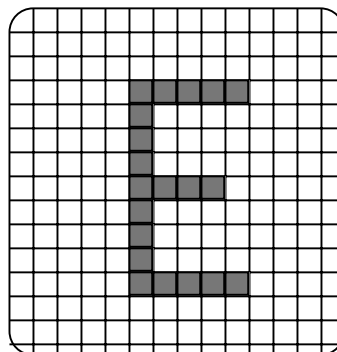


- i.e. Sony Trinitron
- Phosphors arranged in vertical stripes
- Shadow mask is a vertical "grill"

Scanning An Image



- Frame: image to be scanned on CRT
- Frame must be "refreshed" to eliminate flicker in the image.
- Critical Fusion Frequency
 - Typically 60 times/sec for raster displays
 - Varies with intensity, individuals, phosphor persistence, lighting, ...



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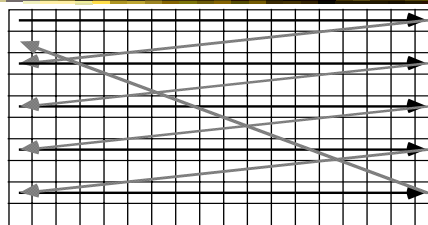
Interlaced Scanning



- Assume can only scan 30 times/sec
- To reduce flicker, divide frame into two "fields" (odd and even lines)

1/30 SEC		1/30 SEC	
1/60 SEC	1/60 SEC	1/60 SEC	1/60 SEC
FIELD 1	FIELD 2	FIELD 1	FIELD 2
FRAME		FRAME	

Scanning



VERTICAL SYNC PULSE— Signals the start of the next field.

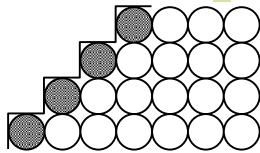
VERTICAL RETRACE— Time needed to get from the bottom of the current field to the top of the next field.

HORIZONTAL SYNC PULSE— Signals the start of the new scan line.

HORIZONTAL RETRACE— Time needed to get from the end of the current scan line to the start of the next scan line.

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Resolution and Addressability

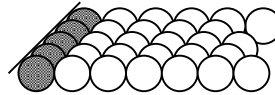


Resolution = Addressability

Addressability is a measure of the spacing between the centers of those lines.

(Everybody, incorrectly, uses **resolution** when they mean **addressability**.)

Resolution is a measure of the width of a single line drawn on the CRT screen (1/spotsize). Usually stated as the number of just merged lines per inch or centimeter.

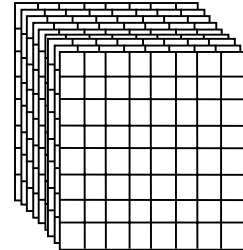


Resolution < Addressability

Smooths out the "jaggies" but the overlap will cause filled areas to be brighter than lines, and lines to be brighter than single pixels.

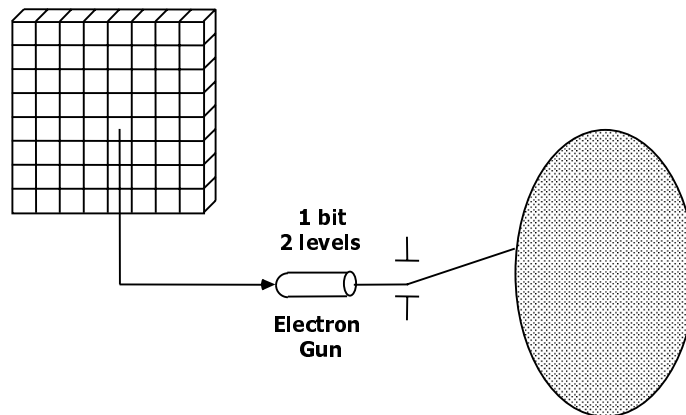
Frame Buffers

- 2D array
 - each (x,y) location = a pixel
- *Bit Planes, Bit Depth*
 - number of bits in a pixel
- Typical frame buffers:
 - 640 x 480 x 8
 - 1280 x 1024 x 8
 - 1280 x 1024 x 24

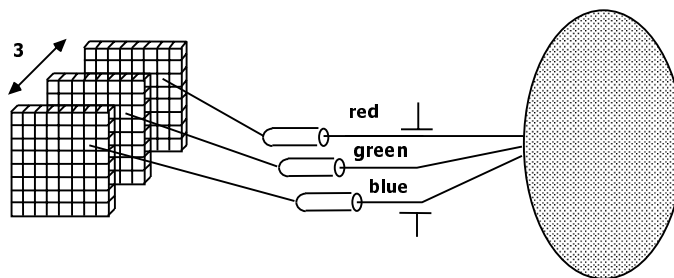


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1-Bit = Monochrome Display (Bit-map Display)



3-Bit Color Display

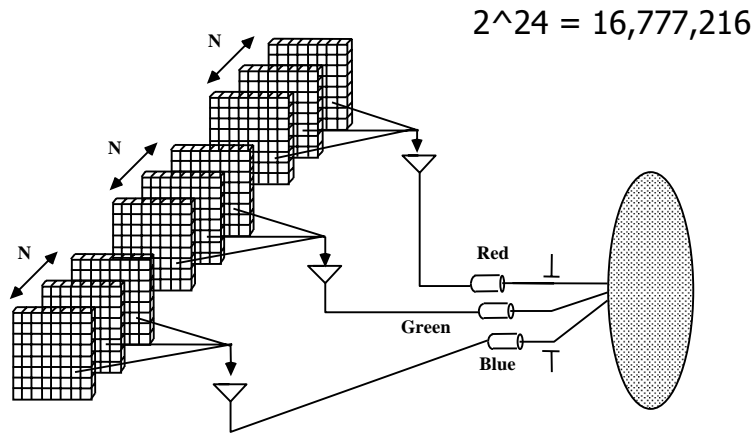


COLOR: black red green blue yellow cyan magenta white

R	0	1	0	0	1	0	1	1
G	0	0	1	0	1	1	0	1
B	0	0	0	1	0	1	1	1

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True Color Display 24 bitplanes, 8 bits R/G/B



Color Map Look-Up Tables

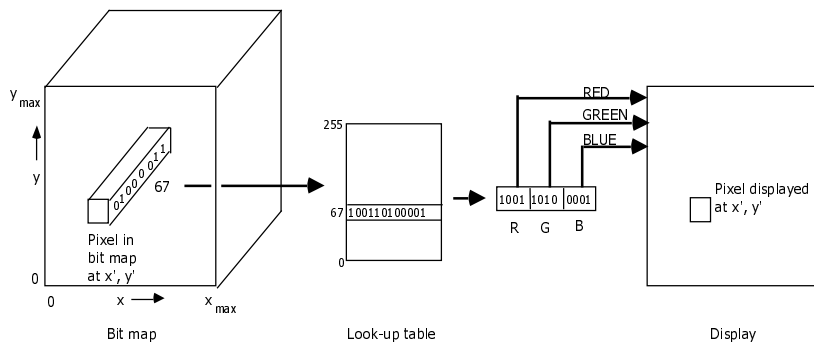
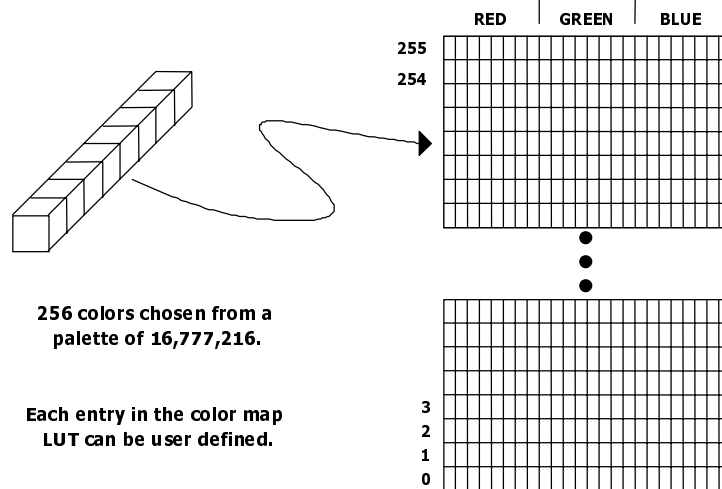


Fig. 4.LUT Video look-up table organization. A pixel with value 67 (binary 01000011) is displayed on the screen with the red electron gun at 9/15 of maximum, green at 10/15, and blue at 1/15. This look-up table is shown with 12 bits per entry. Up to 24 bits per entry are common.

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Pseudo Color: $2^8 \times 24$ Color Map LUT



Display Processor

- Specialized hardware
 - i.e. scan converts primitives into frame buffer
- Fundamental difference between graphics systems
 - work done by display processor vs. CPU

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Video Controller



- Cycles through frame buffer
 - FB contents used to control the electron beam intensity (color)

