

Computer Graphics

LECTURE 04

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Last Class

- ▶ Overview of Graphics Systems
 - ▶ Display Devices
 - ▶ Colors and colored displays
 - ▶ Raster displays and frame buffer

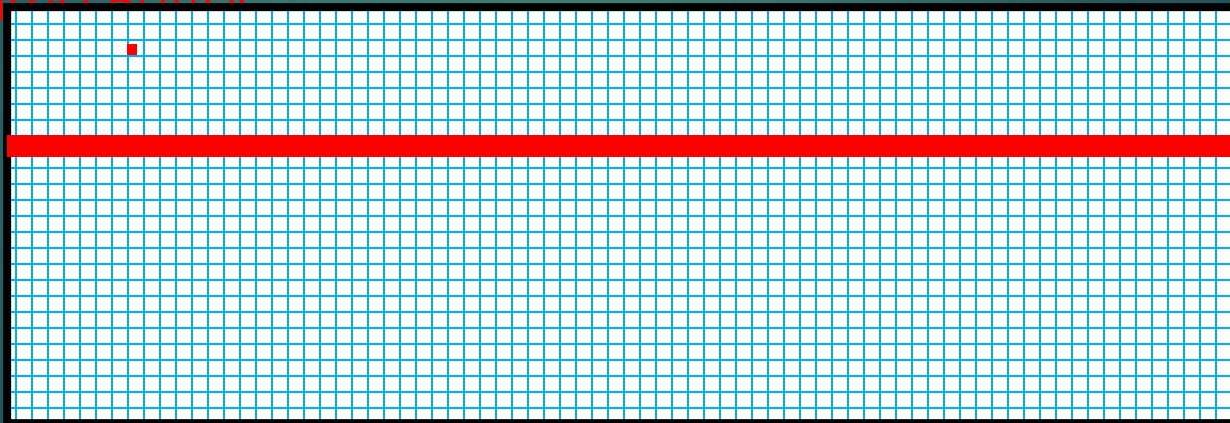
Today's Agenda

- ▶ Overview of Graphic Systems
 - ▶ Vector Displays
 - ▶ Movie Standards
 - ▶ LCD's

Some Definitions

- ▶ A rectangular array of points or dots is called **Raster**.
- ▶ A **Pixel** is picture element of raster.
- ▶ A row of pixels is known as **Scan Line**.
- ▶ Picture elements stored in memory are called **Frame Buffer**.

Scan
Line



Resolution

- The **Resolution** is defined as the number of dot per inch or centimeter that can be plotted horizontally & vertically.
- Higher the resolution, smaller the spot size.
- Resolution is related with quality of the graphics system.
 - Higher the resolution, better the graphics system
 - High quality resolution is 1280x1024
- The intensity distribution of spots on the screen has Gaussian distribution.
- Adjacent points will appear distinct as long as their separation is greater than the diameter at which each spot has intensity of about 60% of that at the center of the spot.

Aspect Ratio

S

- ▶ The **Aspect Ratio** is the ratio between number of scan lines in a raster and the number of pixels in a scan line necessary to produce equal length lines in both directions on the screen.
- ▶ For example 1280 x 768 has an aspect ratio of 5:3.

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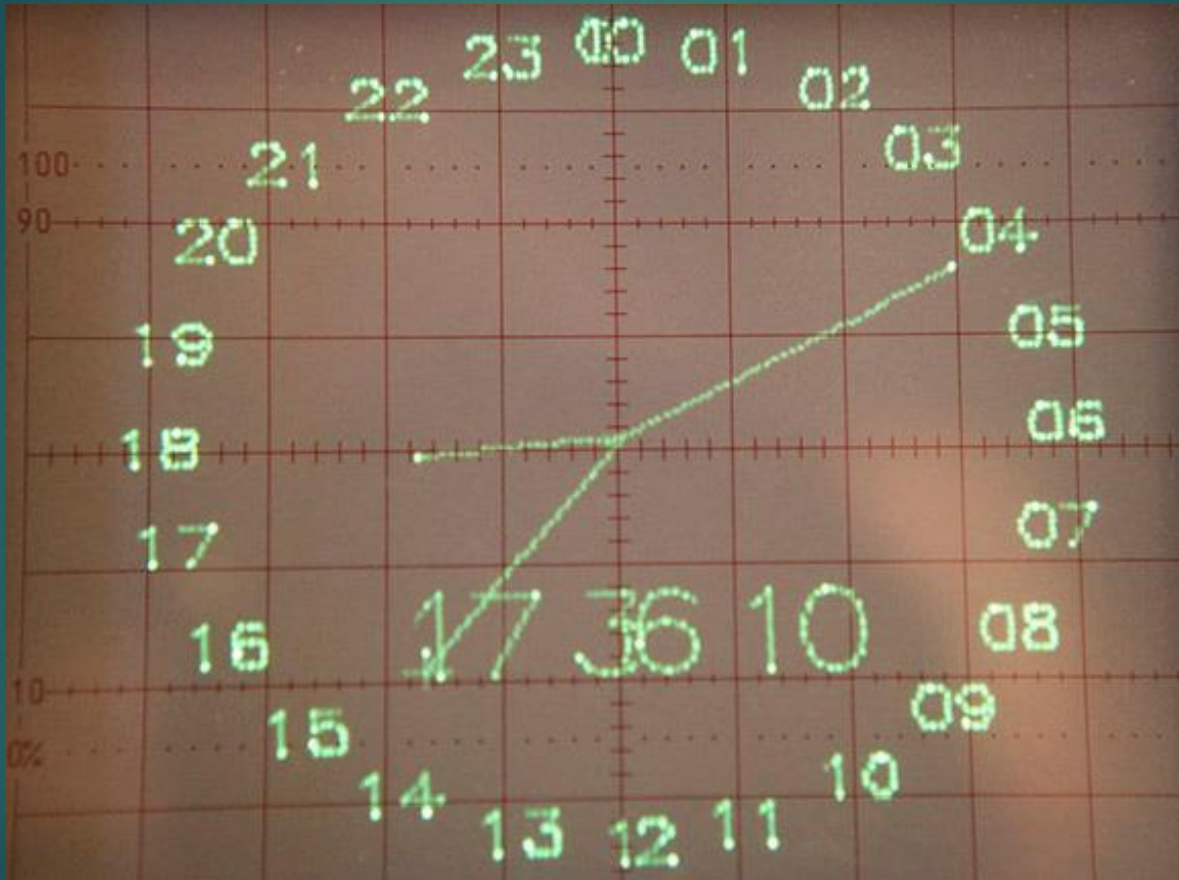
Vector Display

- ▶ The electron beam illuminates only the parts of the screen where a picture is to be drawn.
- ▶ Works like plotters i.e. draws a one picture line at a time
- ▶ Used in line drawing and wireframe displays
- ▶ Picture definition is stored as a set of line-drawing commands stored in a refresh display file.
- ▶ Number of lines derive Refresh rate and refresh cycle is between 30 and 60 per second
- ▶ Can draw 100,000 short lines at this refresh rate

Vector Displays

- ▶ Advantages
 - ▶ Resolution is higher than raster
 - ▶ Line drawings are smooth
- ▶ Vector displays are not suitable for realistic shaded scenes

Vector Display



<http://hackaday.com/2012/12/05/vector-thingy/>

Movie Theaters

- ▶ Films play at 24 fps by U.S. film projectors
 - ▶ Projectors have a shutter to block light during frame advance
 - ▶ To reduce flicker, shutter opens twice for each frame – resulting in 48 fps flashing
 - ▶ 48 fps is perceptually acceptable
- ▶ European film projectors play film at 25 fps
 - ▶ American films are played ‘as is’ in Europe, resulting in everything moving 4% faster
 - ▶ Faster movements and increased audio pitch are considered perceptually acceptable

Movie at Home

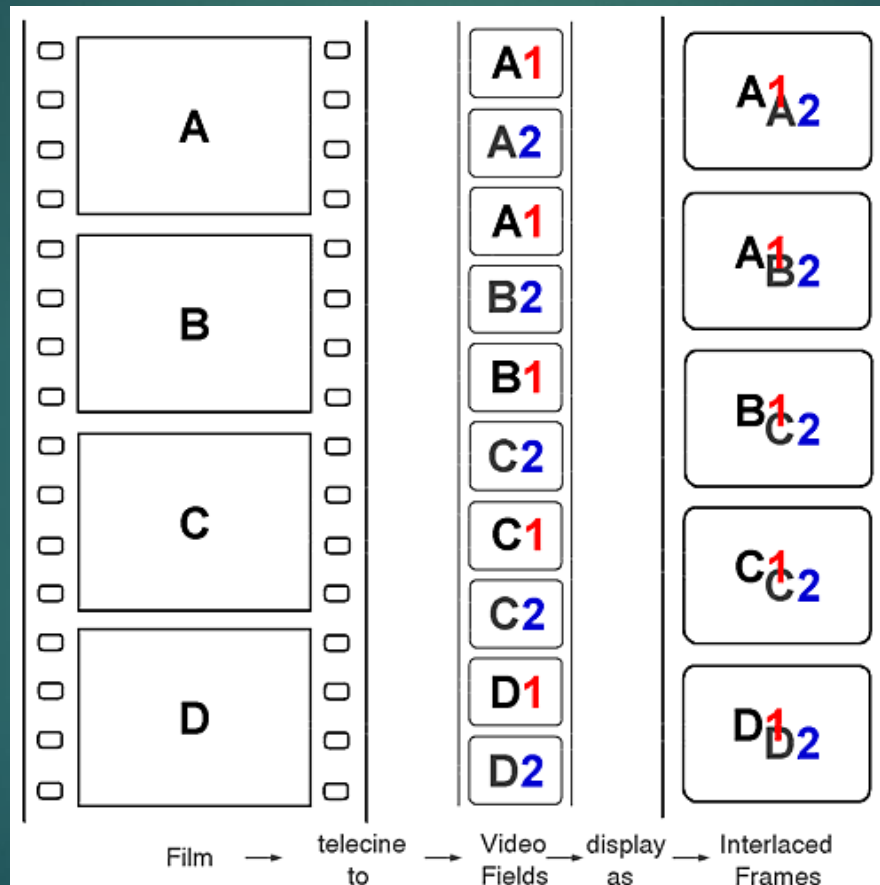
- ▶ Film to DVD transfer

- ▶ Problem: 24 film fps must be converted to
 - ▶ NTSC U.S. television interlaced 29.97 fps 768x494
 - ▶ PAL Europe television 25 fps 752x582

- ▶ Use 3:2 Pulldown

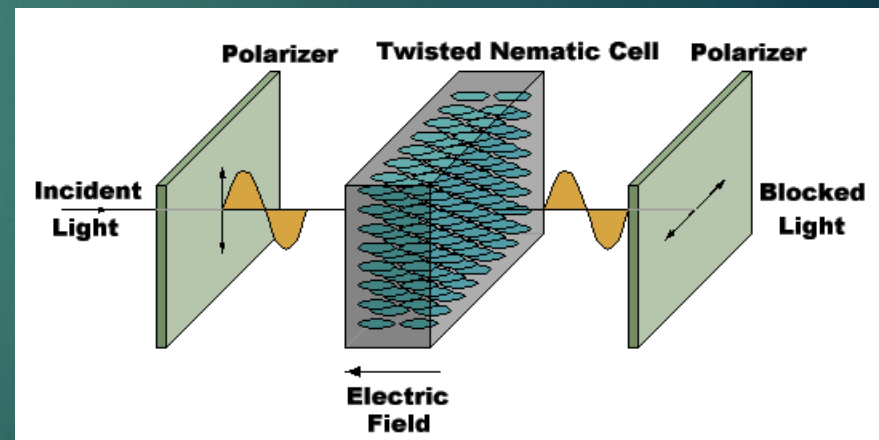
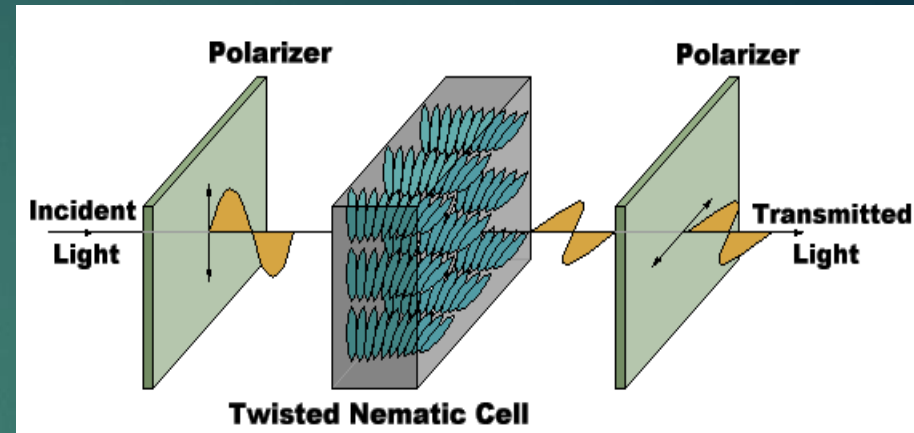
- ▶ First frame of movie is broken into first three fields (odd, even, odd)
- ▶ Next frame of movie is broken into next two fields (even, odd)
- ▶ Next frame of movie is broken into next three fields (even, odd, even)...

Movie at Home



Liquid Crystal Display

- ▶ Liquid crystal displays use small flat chips which change their transparency properties when a voltage is applied.
- ▶ LCD elements are arranged in an $n \times m$ array call the LCD matrix
- ▶ Level of voltage controls gray levels.
- ▶ LCDs elements do not emit light, use backlights behind the LCD matrix



LCD

- ▶ Color is obtained by placing filters in front of each LCD element
- ▶ Usually black space between pixels to separate the filters.
- ▶ Because of the physical nature of the LCD matrix, it is difficult to make the individual LCD pixels very small.
- ▶ Image quality dependent on viewing angle.



Advantages of LCD

- ▶ Flat
- ▶ Lightweight
- ▶ Low power consumption

Summary

- ▶ Overview of Graphics Systems
 - ▶ Movie Standards
 - ▶ LCD's

References

- ▶ Fundamentals of Computer Graphics Third Edition by Peter Shirley and Steve Marschner
- ▶ Interactive Computer Graphics, A Top-down Approach with OpenGL (Third Edition) by Edward Angel.