CSCI E-234 Introduction to Computer Graphics HW1 - Written Part

Russell Lowke, Oct 13th 2004

Part 1 (5 points). Search online to find information about a new display technology and write a short, two paragraph summary of how it works plus a short list of the pros and cons. Choose one of the following:

- LCD on silicon
- Field Emission Devices (FEDs)
- Color Nanotube Displays (CNDs)
- Organic Light Emitting Diodes (OLEDs)
- Electronic Ink

Organic Light Emitting Diodes (OLEDs)

Todays LCD display devices are not perfect, they are fragile, relatively heavy, have a limited effective viewing angle, and are inefficient, blocking 95% of backlit illumination. The current favorite to replace LCDs is Organic Light Emitting Diodes (OLEDs), a technology pioneered and patented by Kodak/Sanyo. These devices are based on organic self-luminous compounds that emit light when a current is passed through them, the result is an extremely thin full motion display with excellent contrast and color, all with a very low power consumption.

The basic OLED structure consists of a stack of thin organic layers sandwiched between a transparent anode and a metallic cathode. When a voltage is applied to the cell, typically between 2 and 10 volts, injected charges combine in the emissive layer to produce electro luminescence (light). There are two forms of OLED displays, 1) passive-matrix [low-cost], using an array of OLED pixels connected by intersecting anode and cathode conductors and 2) active-matrix, uses an integrated electronic back plane as its substrate allowing higher-resolution and higher display speeds.

Advantages: 1) Robust and portable, plastics make OLEDs tough and quite rugged, 2) clear distinct image even under bright light, 3) fast, bendable, paper thin, high resolution display, 4) production costs up to %20 to %50 cheaper than LCD to produce, 5) lighter and faster than LCDs, 6) very good power usage, no need for lamps, polarizers, or diffusers.

Disadvantages: 1) Engineering Hurdles, OLED technology is still in development, 2) a non uniformity of output across the entire screen, and accuracy of color, 3) longevity, the most critical hurdle facing OLEDs, after only one months use the screen starts to fade, with reds and blues dying first and leaving a very green display. 100,000 hours for red, 30,000 for green and 1,000 for blue. Until the short lifespan of the blue color can be overcome OLEDs will remain a speculative technology.

Web sources:
http://komar.cs.stthomas.edu/qm425/01s/Tollefsrud2.htm
http://www.space.com/businesstechnology/technology/ontheedge_0308.html
http://www.pcmag.com/article2/0,1759,1566133,00.asp

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Part 2 - Drawing twice in XOR mode equals drawing not at all (5 points)
[from Hill, 10.3.6, p 553]

Show, for any pixel colors *A* and *B*, that drawing *B* twice in XOR mode leaves *A* unchanged; that is, show that (*A* XOR *B*) XOR *B* is *A* itself.

"xor" stands for "exclusive or," or exclusive disjunction. It yields true if exactly one (but not both) of two conditions is true.

The binary XOR operator has the following truth table.

A	*B*	*A* XOR *B*
T	T	F
T	F	T
F	T	T
F	F	F

For instance, the bitwise XOR of:

01 1011 0110
11 0001 1101 is

10 1010 1011

If we call pixel color *A* = [1011 0110] and pixel color *B* = [0001 1101], when drawing *B* once, *A* XOR *B*, and putting the result back into *A* we see that:

A [1011 0110]   *A* = *A* XOR *B*
B [0001 1101] =

A [1010 1011]

Now, with a second drawing *A* XOR *B* in similar fashion we see:

A [1010 1011]   *A* = *A* XOR *B*
B [0001 1101] =

A [1011 0110]

So, *A* has been returned back to it's original form. Thus drawing *B* twice in XOR mode over *A* will result in *A* being the same as it's original value, unchanged.

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Part 3 - Swapping two images in place (5 points)

[from Hill, 10.3.8, p 553]

Show that two pixmaps *A* and *B* may be interchanged by performing the following three XOR combinations (when the process is complete, *A* contains the pixels values originally held by *B*, and vice versa):

A = A XOR B;
B = A XOR B;
A = A XOR B;

If we call pixmap *A* = [1011 0110] and pixmap *B* = [0001 1101], when performing the operations *A* = *A* XOR *B*, *B* = *A* XOR *B*, and *A* = *A* XOR *B*, we see that:

A [1011 0110]	*A* = *A* XOR *B*
B [0001 1101] =	
A [1010 1011]	

A [1010 1011]	*B* = *A* XOR *B*
B [0001 1101] =	
B [1011 0110]	*B* now resembles the original *A*

A [1010 1011]	*A* = *A* XOR *B*
B [1011 0110] =	
A [0001 1101]	*A* now resembles the original *B*

The two pixmaps have been effectively interchanged, with *A* now equaling the original value of *B*, and *B* equaling the original value of *A*. So we can see that the XOR operation is an effective way of interchanging pixmaps.