ECE 280 / CSE 280
Digital Design Laboratory
Lecture 8

Video
Simple Scanning TV

- Electron beam scans across
- Turned off when
  - Scanning back to the left (horizontal retrace)
  - Scanning to the top (vertical retrace)
Scanning

- TVs use *interlacing*
  - Every other scan line is swept per field
  - Two fields per frame (30Hz)
  - Way to make movement less disturbing

- Computers use progressive scan
  - Whole frame refreshed at once
  - 60Hz or more, 72Hz looks better
Color

- Three colors of phosphor
- Beams hit each
- Black – beam off
- White – all on
VGA Signaling

- RGB and two synchronization pulses, horizontal and vertical
VGA Timing

• Monitor synchronizes with input in more complex way than keyboard

• You supply two pulses, hsync and vsync, that let the monitor lock onto timing

• One hsync per scan line

• One vsync per frame
Horizontal Timing Terms

• hsync pulse
• Back porch (left side of display)
• Active Video
  – Video should be *blanked* (not sent) at other times
• Front porch (right side)
Horizontal Timing

640 Horizontal Dots
Horiz. Sync Polarity NEG
Scanline time (A) 31.77 us
Sync pulse length (B) 3.77 us
Back porch (C) 1.89 us
Active video (D) 25.17 us
Front porch (E) 0.94 us
Vertical Timing (note ms, not us)

Vert. Sync Polarity NEG

Vertical Frequency 60Hz

Total frame time (O) 16.68 ms

Sync length (P) 0.06 ms

Back porch (Q) 1.02 ms

Active video (R) 15.25 ms

Front porch (S) 0.35 ms
Timing as Pixels

- Easiest to derive all timing from single-pixel timing

- How long is a pixel?
  - Active video / number of pixels
  - 25.17 us / 640 = 39.32ns
  - Conveniently close to 25 MHz – just use that
## Timing as pixels

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Vertical</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time</td>
<td>Pixels</td>
</tr>
<tr>
<td>Period</td>
<td>16.672 ms</td>
<td>416800</td>
</tr>
<tr>
<td>Active Video</td>
<td>15.36 ms</td>
<td>384000</td>
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<tr>
<td>Sync pulse width</td>
<td>64 µs</td>
<td>1600</td>
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<tr>
<td>Back Porch</td>
<td>928 µs</td>
<td>23200</td>
</tr>
<tr>
<td>Front Porch</td>
<td>320 µs</td>
<td>8000</td>
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Lab 7

• Video sync generator
  – Spartan-3 board has three RGB bits for a total of 8 colors
  – Use three switches to select color
  – Display color on screen
Announcements

- I will be out of town Monday and Tuesday
  - Office hours on Wed 2-5

- Start thinking about final project ideas
  - Talk to me about it in the next few weeks
  - Ideas from FCCM, FPGA, FPL conferences