Funny Sound Board

E4840 Spring 2011 Final Project
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Goal was to make a project that generate laughs

- Click a button to play sound
- Put it at place where people wait
Use DE2 board to make this possible
SD card interface is through software

- Altera supplies example driver
- We were able to optimize it a bit
- Hardware implementation would be much faster
Files are stored on SD card just like on a hard drive

- FAT16 software is ported from external source\(^1\)
- We used a very simple file system
- Assume no fragmentation and read only

\(^1\) copyright © 2000 - 2011, Glen George.
Mouse is also software driven

• Similar to keyboard from Lecture 3
• Need to translate mouse data points into smooth motion
• We used the bouncing ball method from lab3 to interface the mouse with the VGA controller
Audio is complicated on the DE2

- Make sure I2C initialization is correct
- Set the correct clock frequency and modes.
- Complicated issue! Whole masters thesis have been spent on just this interface alone!
We wanted large pictures and video-like animation

- Need to display multiple high-resolution color frames
- 640 x 480 x 16 bits/pixel => 600 KB/Frame

- Do not have enough memory on board
- Did not have resource to implement decompression (JPEG, MPEG, etc)
Solution is to use SDRAM as frame buffer

- VGA controller need to access SDRAM directly
- Then stores pixel data in local line buffer
Add VGA component as Avalon Master

- Use SOPC
- Implement state machine to read memory
Pitfalls to avoid – bus width issues

Dynamic Bus Sizing Master-to-Slave Address Mapping

<table>
<thead>
<tr>
<th>Master Byte Address (1)</th>
<th>When Accessing an 8-Bit Slave Port</th>
<th>When Accessing a 16-Bit Slave Port</th>
<th>When Accessing a 64-Bit Slave Port</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0x00</strong></td>
<td>OFFSET [3] 7..0; OFFSET [2] 7..0;</td>
<td>OFFSET [3] 15..0; OFFSET [2] 15..0</td>
<td>OFFSET [0] 31..0</td>
</tr>
<tr>
<td></td>
<td>OFFSET [1] 7..0; OFFSET [0] 7..0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>0x04</strong></td>
<td>OFFSET [7] 7..0; OFFSET [6] 7..0;</td>
<td>OFFSET [3] 15..0; OFFSET [2] 15..0</td>
<td>OFFSET [0] 63..32</td>
</tr>
<tr>
<td></td>
<td>OFFSET [5] 7..0; OFFSET [4] 7..0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OFFSET [9] 7..0; OFFSET [8] 7..0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OFFSET [13] 7..0; OFFSET [12] 7..0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes to Table 3–3:
(1) Although the master is issuing byte addresses, it is accessing full 32-bit words.
(2) For all slave entries, [<n>] is the word offset and the subscript values are the bits in the word.

- Make sure words are aligned to ensure bug-free
- Use DWORD read/write to avoid waste
Performance of VGA is bad due to SDRAM latency

- SDRAM in random access mode can only supply ~100 pixels per line in real time
- Pixilation and raster line skipping as a result
- Effectively operating at reduced resolution

Need to operate in pipeline or burst mode! => More complicated state machine
Audio playback was noisy and slightly slow

• Maybe due to setup of codec chip and audio core
• Could be from our source files which were up-sampled to 48KHz
• We sent data to codec directly from SD card, perhaps buffering could improve performance
Thanks to Dr. Edwards for an enlightening semester of class!