PIP: The Plug-In Player

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What’s the PIP?

- MP3 Player
- Any USB Mass Storage Device
- IR remote
- Touchscreen display
Why the PIP?

- No internal hard drive
- Can use any USB mass storage device
Features I

- Touchscreen LCD Display & Interface
  - 2.8” 18-bit color Thin Film Transistor Liquid Crystal Display
    - Resistive touchscreen
    - 320x240 resolution
    - 10-bit touch resolution
    - Finger and stylus touch capable

- Multiple Audio Formats
  - MP3
  - WAV
  - WMA
  - MP4
Features II

- Remote Controlled
  - Small Infrared Remote
  - Next/Previous Song
  - Volume Control
  - Play/Pause
  - Approximately 25 foot range
- Multiple Media Sources
  - USB
  - SD Card
Features III

- Easy-to-Use Graphical User Interface
- Runs off rechargeable battery
  - Up to 25 hours of battery life
- Make Custom Playlists On-The-Fly
  - Store playlists on SD Card
- Bass & Treble Control
  - Adjustable cutoff frequency and amplitude
Processor

- ATMEL UC3A
  - 512 KB of Program Memory
  - 66 MHz Clock
  - 144 Pin LQFP
  - 3.3 V Power

- Why did we choose it?
  - A lot of support for it from Atmel and online community
  - Supports all of the peripheral functions that we need
    - USB
    - SPI
    - ADC
  - Visual Studio
  - AVR Dragon Programmer
Memory

- Micron Technology SDRAM
  - 64 MB
  - 133 MHz
  - 16-bit data width
  - Volatile memory
- Why did we choose it?
  - Big enough for our application
  - Micron has a great reputation for manufacturing SDRAMs
MP3 Decoder

- VLSI VS1053B
  - Provides volume, bass and treble control
  - 18-bit DAC
  - Built-in amplifier
  - Programmable
  - Zero-cross detection for smooth volume change

- Why did we choose it?
  - Decodes multiple audio formats, not just MP3
  - SPI Interface
  - Straight-forward implementation
LCD

- Ilitek ili9325
  - Resistive Touchscreen
  - Adjustable gamma control
  - 8-bit data
  - Internal GRAM for storing the image

- Why did we choose it?
  - Graphics library available
  - Touchscreen capable

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**system 8-bit interface (2 transfers/pixel) 65,536 colors**

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<td>DB 3 DB 2 DB 1 DB 0</td>
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Power

- Linear Technology LTC3521 Buck-Boost Converter
  - High efficiency DC/DC converter
  - 1.8 to 5.5 V input voltage range
- Why did we choose it?
  - High efficiency
  - Great documentation
  - Does not get hot
Other Parts

- USB
- SD Card
  - On SPI Bus
- IR Receiver
  - Receives 38 KHz Infrared signal and converts to PWM signal that the processor can decode
- Audio Jack
  - Allows connectivity to any stereo
Where does the data go?

- Music data originates from SD Card or USB drive
  - Processor moves song from the storage device to the SDRAM for quick access.
- Through the UI the user selects a song, the data goes back through the processor to extract song information and then gets sent to the MP3 decoder.
- The processor periodically sends data to the MP3 decoder, the decoder consumes the data and outputs it to speakers.
Software Design

- No Operating System
- Wrote low-level drivers for all subsystems first
  - Atmel provides the Atmel Software Framework, libraries that helped us initialize some of the peripherals.
  - Each subsystem had a test program that showed it working
- Then combined all the code, and developed the GUI
- From the GUI, we slowly added functionality to our design
- Every peripheral except the touchscreen is on interrupts
Graphical User Interface Development

Now Playing
One.mp3
Prev: Master of Pupp...
Next: Sweet Child O...

Playlists on Card:
1. Metallica
2. Guns N Roses
3. Rock

New Moon Rising
Cosmic Egg
Wolfmother

Folder Name 1
Folder Name 2
Folder Name 3
Folder Name 4
Folder Name 5
Folder Name 6
Folder Name 7
Folder Name 8
Folder Name 9
Folder Name 10
Demo/Video

- Insert video here
Conclusions

- Overall great learning experience
- Most worthwhile class we’ve taken
- We feel we made an excellent choice for the processor
- Spending a lot of time in the hardware design in the Fall paid off and made Spring quarter less stressful.
Problematic Areas

- We had two hardware mistakes, both involving the crystal oscillators
  - The main oscillator for the CPU was on the wrong pins
    - Fix was relatively simple, we cut five traces and wired them to the correct pins
  - The MP3 decoder wasn’t responding
    - The 2 capacitors on it were of the wrong size, removing them fixed the issue
  - From this project, we learned the importance of crystal oscillators
What Would We Change?

- Switch to a capacitive touchscreen.
- Move the LCD display to a bus and use the 16-bit data mode.
- Include a FLASH memory for storing GUI elements.
- Move the IR signal to a pin that supports PWM.
Work Distribution

- Kevin Malby:
  - User-Interface
  - USB
- Michael Holyland:
  - Touchscreen
  - LCD
- Luis Rocha:
  - SD Card
  - MP3 Decoder
- Edward Gabriel III:
  - IR Remote
  - SDRAM
Thank You!

- Professor Butner
- TA Ryan Pakbaz
Questions?

Thank you for your time!