Abstract:
The consumer electronics industry has exploded in recent years, notably with the increasing popularity of portable media devices. The market for mobile entertainment has been steadily growing, leading to an influx of new devices from many different companies. As these devices grow more complex, they become increasingly interesting to study in terms of their architecture and design.

This project aims to gain a deep understanding of these devices through a sample implementation of a digital media player, using a field programmable gate array (FPGA). FPGAs are wonderful tools for designing and prototyping digital systems, since they prevent the need for fabricating real chips. They also present their own interesting challenges—specifically speed and size limitations. The ultimate goal of this project is to construct a digital media player with a simple user interface, capable of presenting pictures, text, games, and audio. Finally, as a beneficial side-effect, the implementation of this device will result in several controller components that can potentially be used for Penn's undergraduate processor design course.

Hardware Design:

Software Design:

Operating System
1. Locate appropriate media in root directory, creating a file list
2. Display file list to user
3. Respond to user input
4. Image, text, or audio selected
5. Program selected
6. Display Media
7. Set Boot Flag
8. Execute Code
9. Clear Boot Flag

Results:
- Created a hardware compact flash interface allowing for simple software to provide permanent storage.
- Created a Boot ROM, allowing dynamic program loading at runtime. This module also reduces hardware synthesis time and allows for software resetting of main memory.
- Created an operating system capable of loading other programs and operating systems stored on disk.

Supported Media:
- ASCII encoded text
- bitmapped images, using 16-bit color at 128 x 124 resolution
- uncompressed wav audio, sampled at 48 KHz
- p37x programs

Usability / Customizability
- Boot ROM explores the native Compact Flash file-system to locate the operating system on startup.
- Upon startup, discovers all relevant media in the CF card’s root directory
- Simple, 3 button user interface
- Operating System / GUI can easily be modified by the user
- Additional media formats can be added as desired

In Progress:
- Created a hardware audio controller that buffers incoming data and constructs properly formatted AC97 frames for the FPGA’s digital-to-analog converter. This audio system is currently buggy, due to sampling rate and formatting issues. These issues should be resolved shortly, completing the design.