

Kanto: FPGA Audio Player and Visualizer

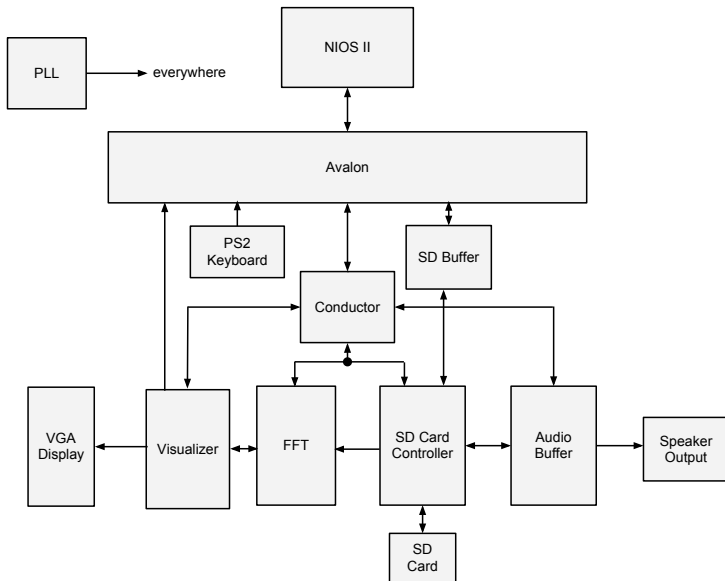
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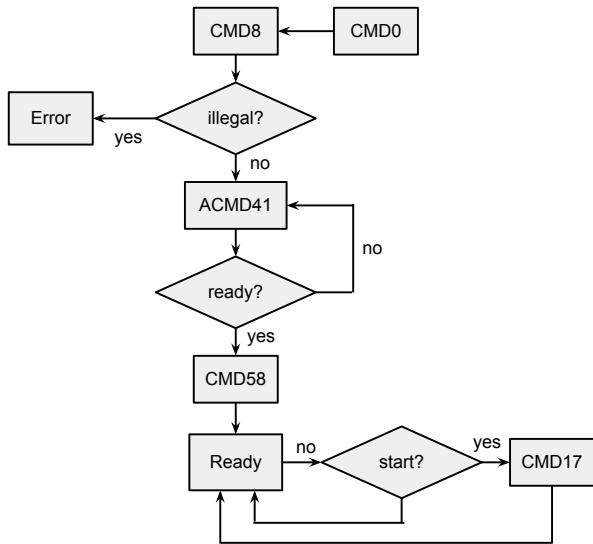
Project Overview

- ▶ Objective: Design and implement an audio player with frequency visualization.
- ▶ Hardware: Handles audio output and frequency visualization
- ▶ Software: Handles user interaction and system initialization

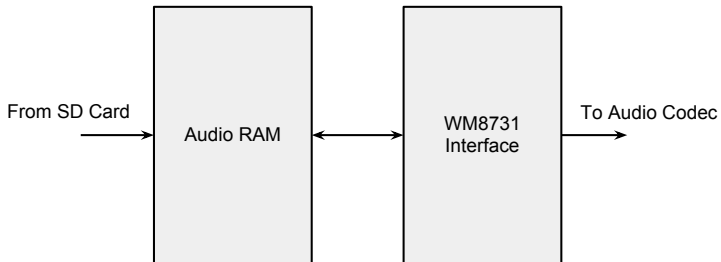
High-Level Overview



SD Controller



Audio Buffer

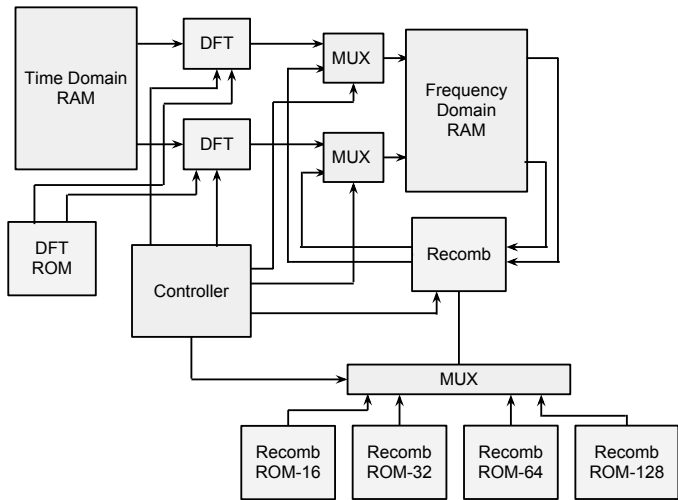


FFT Equations

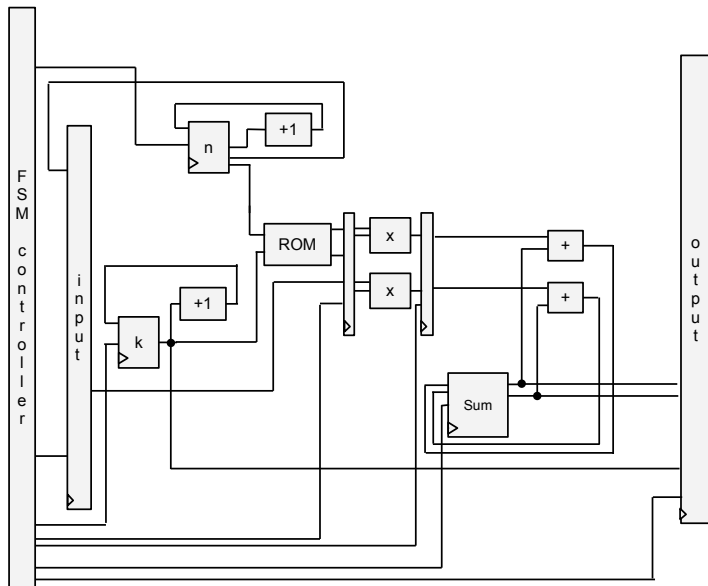
$$X_k = \sum_{n=0}^{N-1} x_n e^{-\frac{2\pi j}{N} nk} \quad (1)$$

$$X_k = \begin{cases} E_k + e^{-\frac{2\pi j}{N} k} O_k & \text{if } k < N/2 \\ E_{k-N/2} - e^{-\frac{2\pi j}{N} (k-N/2)} O_{k-N/2} & \text{if } k \geq N/2. \end{cases} \quad (2)$$

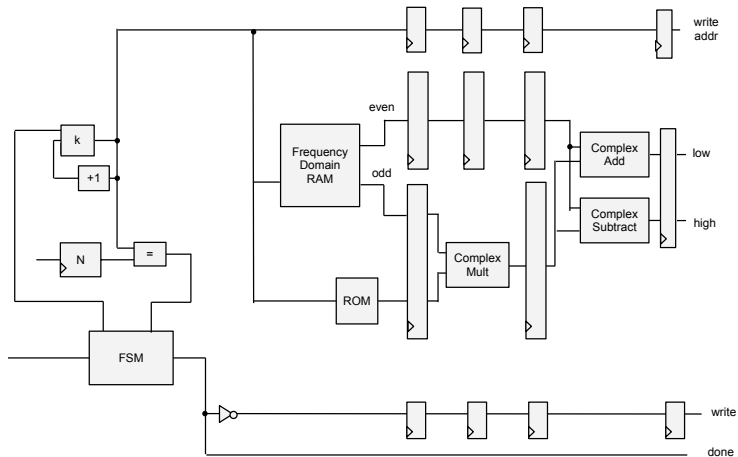
FFT Top-Level



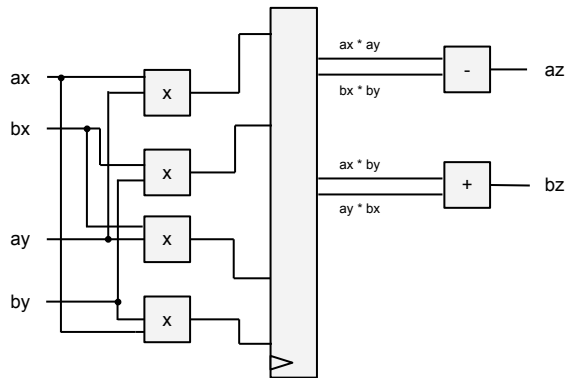
DFT Unit



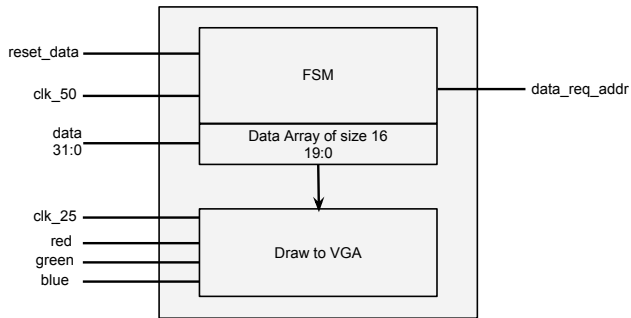
Recombination Unit



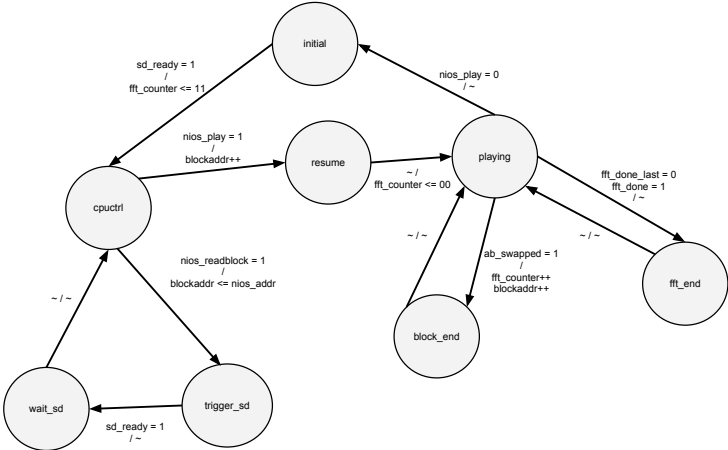
Complex Multiplier



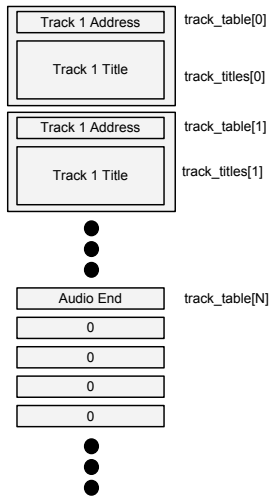
Visualizer



Conductor



Software — Track Selection



The Hard Parts

- ▶ Interfacing to external hardware (SD card, audio codec, visualizer)
- ▶ Reducing Hardware Usage
- ▶ Timing Issues

Design Changes

- ▶ Removal of SRAM
- ▶ Adding Software Control
- ▶ Display Changes

Lessons Learned

- ▶ Connect components early
- ▶ Implement modularized design
- ▶ Testbench everything
- ▶ Clearly define milestones
- ▶ Communicate often and clearly with each other and the adviser