FPGA Music Visualization

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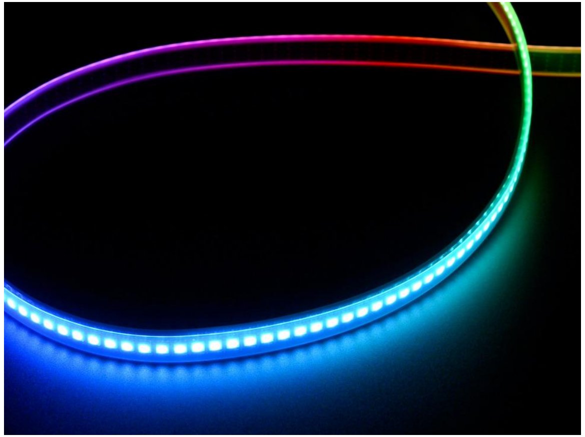
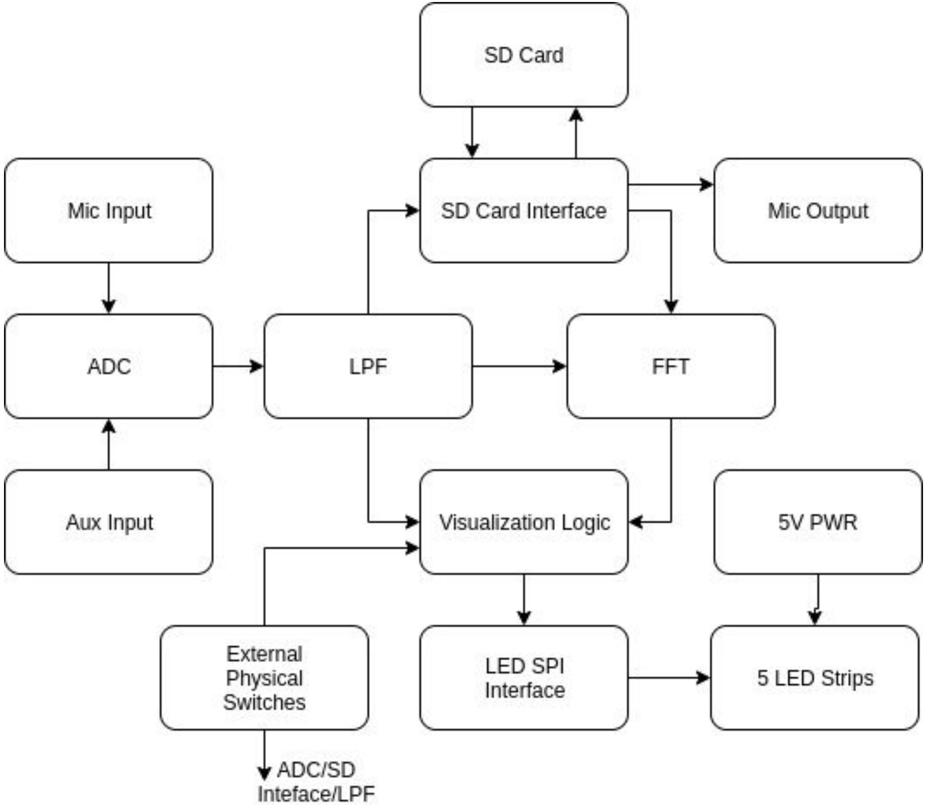
Overview/Block Diagram

- Visualize music frequency space and other significant features (beats, etc) in real time.
- Read/Write Music to SD card for later use, or simply listen to music from mic/aux.
- Control Dot-Star SPI LEDs

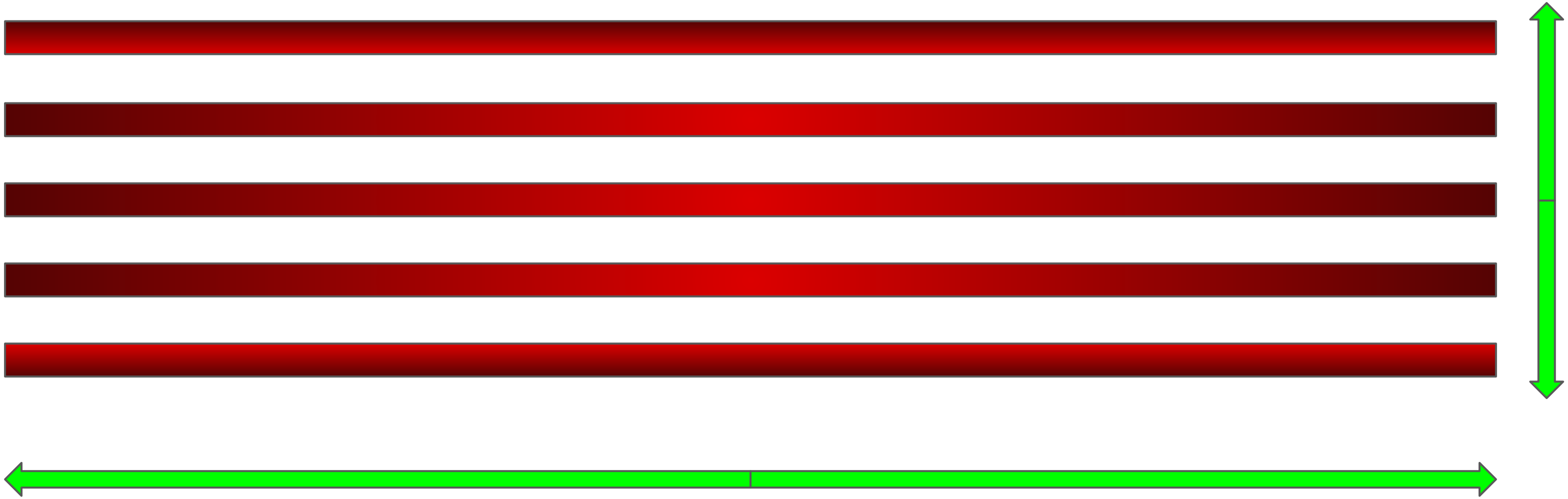




Proposed Visual Output

*DC at center

Increasing Power @ Frequency -> Increasing Vertical Displacement & Brightness



Increasing Frequency -> Increasing Horizontal Displacement

Implementation/Technical Details

- SD Card Interface
  - Will likely use 25Mhz clock
  - FIFO to control timing and synchronize lights and audio
- SPI Interface
  - Both SD card and lights use SPI interface
  - Will likely create separate module for SPI to use for both
- Clocks
  - Internal logic will likely work on 100Mhz clock
  - Free to specify clock rate for LED strip communication (100kHz)

Implementation/Technical Details

- FFT
  - streamed 8 bit data at 1MHz, periodically produce 128 bin output
- Visualization Logic
  - Take data from FFT and audio input.
  - Turn frequency spectrum into corresponding colors/brightness (HSV easiest) at specific LED location
  - Visualize beat by drastically changing color of entire display.
- LED Hardware
  - Wooden plane to secure 5 led strips and 300W 5V power supply
  - Interface with 10 FPGA outputs (clock and signal for each strip)

Timeline

1st Week:

- Implement SD interface by itself, test and implement preliminary version of FIFO
- Implement FFT and LPF, send test signals through to verify functionality

2nd Week:

- Connect SD to LPF, test writing to and playing audio from SD
- Implement lights interface, connect to simple visualization logic and test LPF->FFT->LED logic chain

3rd Week:

- Refine SD interface to synchronize audio and visual output, test entire system together. Debug.
- Implement full visualization logic

4th Week:

- Refine logic to make everything run smoothly, fix bugs
- Implement more complex visualization logic such as beat detection