Audio GUI: MINOS@work

A presentation

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Outline

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Class–Z Amplifier

What I've been working on at Zetex in the last two years:

- Digital class–D amplifier system with feedback
- System consists of two chips: digital modulator + analog feedback
- The digital chip has many features and needs rather complex software to control it
- System developers aren't programmers, and therefore need a GUI. Must run under Windows (customer requirement). Must also run under Linux (my requirement).

Interfacing SPI

- Audio input is via I²S or TDM[1], add a SPDIF decoder to the board, and you are done (SPDIF from PC or CD player)
- Register input is via SPI. Most MPUs have it, desktop PCs don't.
- FTDI has a chip to interface USB to SPI (FT2232C).
  - This comes with a driver and a library (both on Linux and Windows)
  - Basically is a serial port chip with a free programmable bitbang mode

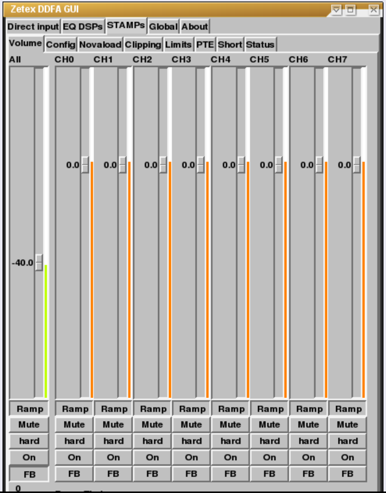
[1] Time Division Multiplex

Requirements

- GUI access to all features
- Direct access as well
- Scriptable
- Save and restore state
- Obtain state from hardware
- Must run without hardware attached for demonstration issues

Hands on

Screen shot



Solutions

State Remember everything written to the device in a list

Run without hardware Bypass library, read from the device list (0 if none)

MINOS Added flag actor for bit in a bit field (very useful to represent hardware registers)

Performance Block readouts from the device, cache information, update periodically

Graphic Equalizer

Most complicated part

- EQ DSP provides up to 14 4th order biquad filters, 12 are used
- Individual filters are calculated to have xdB gain/attenuation at target frequency, and constant Q (so that the gain is $\frac{x}{2}$dB at half or twice the frequency
- Equalizer coefficients are not independent of each others
- Approximative solution: Linear equation system to be solved
- Visualization: Simulate impulse response, FFT the result, an draw it on a double logarithmic scale

Things Learned

- Good exercise to debug Theseus
- Added features to MINOS (like scale factor to sliders and bit–wise state for toggle buttons)
- Components were a good idea (each register is a component)
- Alternative to Theseus–based UI might be to create the GUI out of a formal register description (in Forth syntax)
- Cross–plattform development can work even close to hardware