FM Music Synthesizer

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Overview

The project interface to the user consists of twelve momentary pushbuttons, eight slide switches, a 4-digit 7-segment LED display, five 2-bit rotary encoders. There are entities dedicated to encoding/decoding input/output, such as debouncers, rotary decoders, and a LED display driver. The more interesting stuff happens in the 'voice' or 'synth_key' entity. This entity is what generates all the waveforms. It uses as input some variables that the user controls with switches and rotary encoders, such as frequency or modulation index. These voice entities operate independently, and are each controlled by one of the pushbuttons mentioned earlier. These voice outputs are added together and sent to a DAC and subsequently to a speaker.

Patches implemented for 2 oscillators are:

1. Waveform_0[n] = osc(f_0*n)
   Waveform_1[n] = osc(f_1*n)
   Output = Waveform_0 + Waveform_1

2. Waveform_0[n] = osc(f_0*n + mod_ind_1*Waveform_1[n-1])
   Waveform_1[n] = osc(f_1*n)
   Output = Waveform_0

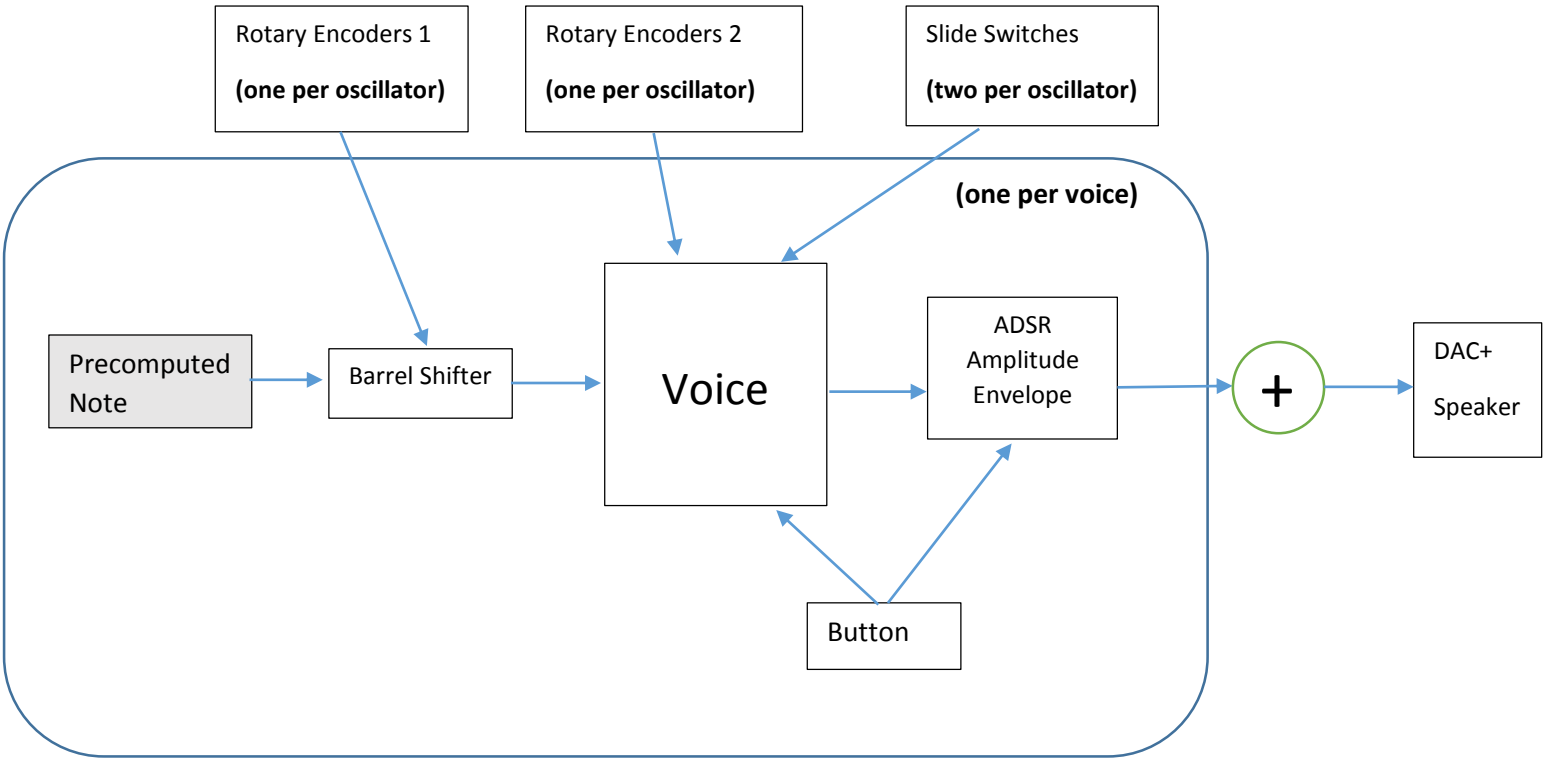
3. Waveform_0[n] = osc(f_0*n + mod_ind_0*Waveform_0[n-1])
   Waveform_1[n] = osc(f_1*n)
   Output = Waveform_0 + Waveform_1

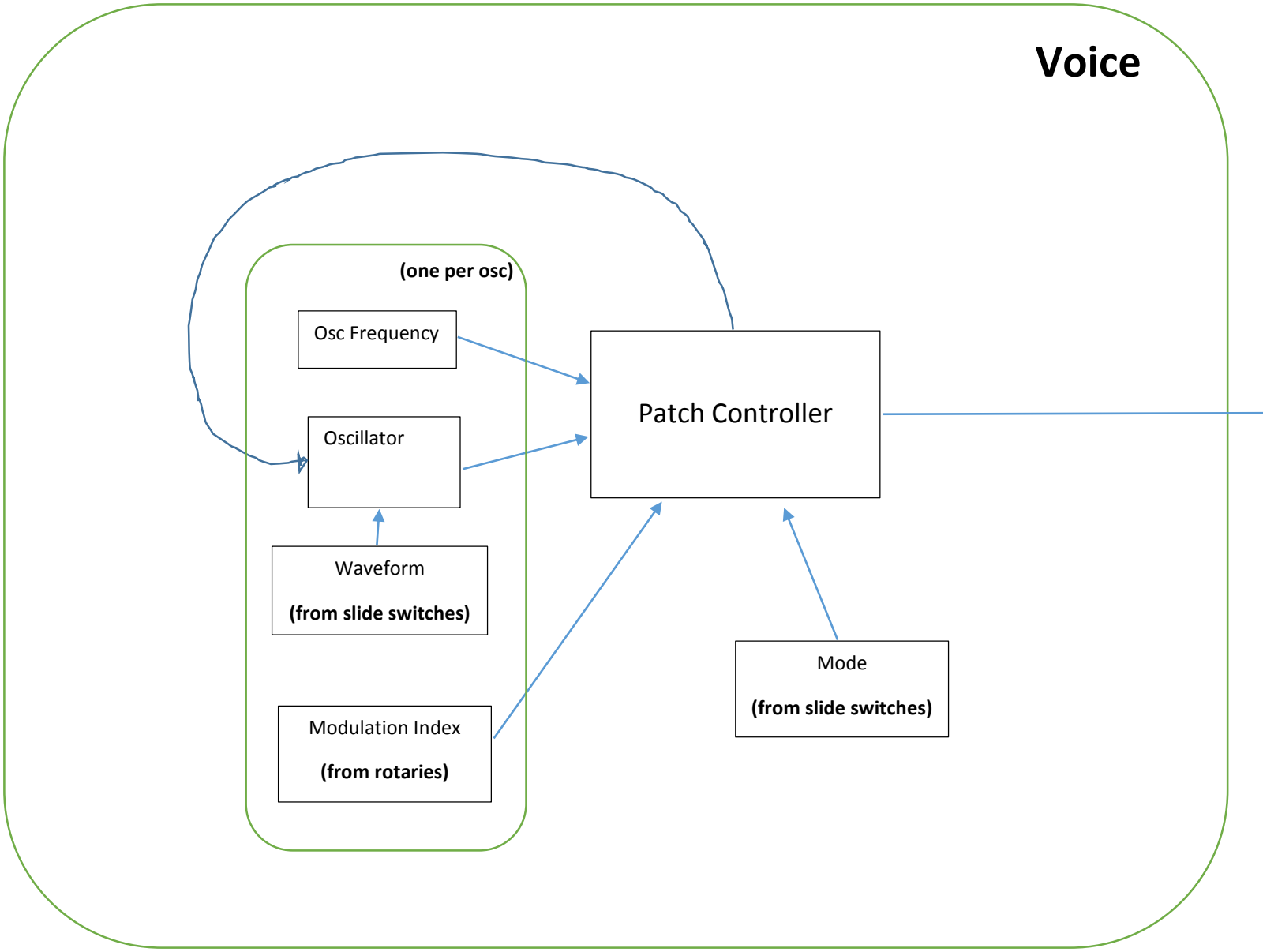
4. Waveform_0[n] = osc(f_0*n+ mod_ind_0*Waveform_0[n-1] + mod_ind_1*Waveform_1[n-1])
   Waveform_1[n] = osc(f_1*n)
   Output = Waveform_0

5. Waveform_0[n] = osc(f_0*n + mod_ind_1*Waveform_1[n-1])
   Waveform_1[n] = osc(f_1*n + mod_ind_1*Waveform_1[n-1])
   Output = Waveform_0

6. Waveform_0[n] = osc(f_0*n + mod_ind_0*Waveform_0[n-1])
   Waveform_1[n] = osc(f_1*n + mod_ind_1*Waveform_1[n-1])
   Output = Waveform_0 + Waveform_1

7. Waveform_0[n] = osc(f_0*n + mod_ind_1*Waveform_1[n-1])
   Waveform_1[n] = osc(f_1*n + mod_ind_0*Waveform_0[n-1])
   Output = Waveform_0 + Waveform_1


Rotary Encoders 1
(one per oscillator)
Rotary Encoders 2
(one per oscillator)
Slide Switches
(two per oscillator)
(one per voice)
Precomputed Note
Barrel Shifter
Voice
ADSR Amplitude Envelope
+
DAC+
Speaker
Button


Voice
(one per osc)
Osc Frequency
Oscillator
Waveform
(from slide switches)
Modulation Index
(from rotaries)
Patch Controller
Mode
(from slide switches)