

Noisemaker Workshop

8-step (Resistive) Sequencer

May 8, 2009

Outline

Talky talky

Worky worky

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Worky worky

Where we're at

The Story Thus Far

- ▶ Made an oscillator out of an inverter chip (with hysteresis), a resistor, and a capacitor
- ▶ Played with various modulation schemes:
 - Frequency mod (through LDR and LED)
 - Gating (tie two oscillators together with diode)
- ▶ Amplifiers: volume and filter
- ▶ Today? Sequencing

Simple Sequencer

Three Chips, One Speaker

- ▶ Instead of one resistor in our oscillator, use eight different resistors and switch between them rhythmically
- ▶ An eight-way switch (74HC4051)
- ▶ A counter (74HC193) to select the eight different switch poles
- ▶ An 74HC14 for a clock to drive the counter, an oscillator for sound, and a buffer amp for direct output
- ▶ Breadboard, lots of resistors, a few capacitors
- ▶ (Whatever else you want to throw at it)

The Counter

...counts up in binary

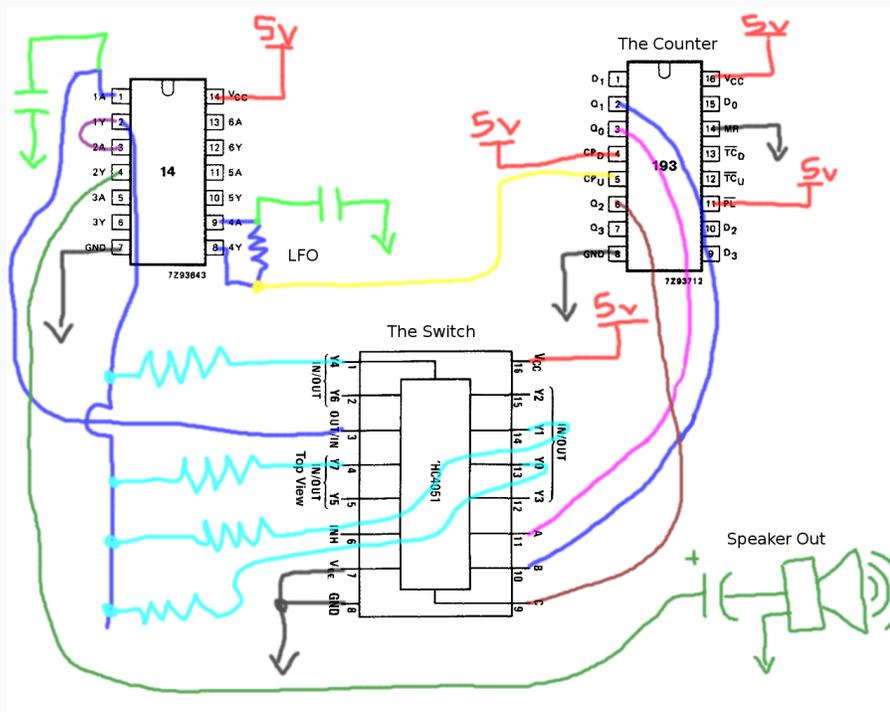
- ▶ A low-frequency oscillator (rhythm clock) on the 74HC14 feeds into the counter
- ▶ The counter counts positive transitions, and reflects the number that it has counted so far
- ▶ Every transition, the first output (Q0) toggles
- ▶ Every two transitions, the second output (Q1) toggles
- ▶ Every four transitions, the third output (Q2) toggles
- ▶ Every eight transitions, the fourth output (Q3) toggles
- ▶ Binary Refresher: (On board)

The Switch

...switches

- ▶ The switch (conveniently) has a 3-bit binary input
- ▶ Connects one in/out to one of eight out/in's
- ▶ 000 is switch one
- ▶ 101 is switch ??
- ▶ (six)
- ▶ 111 is switch ??
- ▶ (eight)
- ▶ Take three wires from counter, hook into switch selector
- ▶ Connect in and outs of the switch, through different resistors, into the feedback loop of our pitch oscillator

The Sequencer



Breadboarding

Introduction to the board of intermittent contact

- ▶ Breadboards are very convenient for a quick mock-up
- ▶ Rows are connected to each other
- ▶ Vertical busses are great for ground and power
- ▶ Things don't want to live on breadboards
it's a reusable prototyping tool
- ▶ Myself, once I get it working in a nice enough state,
I take few photos
- ▶ Then, working from the photos, you can re-create the circuit
in solder and wire at your leisure

The Gotchas

Decoupling

- ▶ With this many digital logic circuits, you will probably need a capacitor between the 5v and GND rails

Counter

- ▶ Pull CP_D , downward-counting direction pin, high
- ▶ Pull \overline{PL} , parallel load input pin, high
- ▶ Pull MR , master reset pin, low

Switch

- ▶ To put it in analog mode, V_{EE} needs to be grounded
- ▶ May need to ground the INH (inhibit) pin

Outline

Talky talky

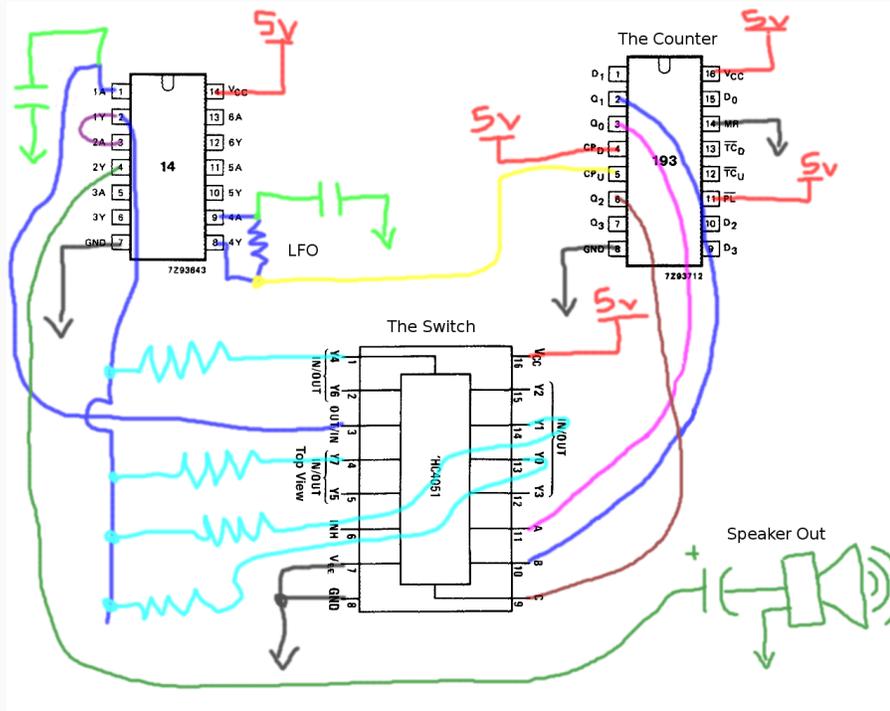
Worky worky

Wire it up

Incremental debugging FTW

- ▶ We should probably build this circuit up in stages
- ▶ Use an LED to test digital signals along the way
- ▶ Get low-frequency oscillator working/blinking
- ▶ Then feed it into counter, verify counter outputs
- ▶ Feed counter into switch, plug 5v into switch high, verify switching with LEDs
- ▶ Then connect up audio oscillator (verify with speaker)
- ▶ Finally, put switch and its resistors into audio oscillator feedback path

The Sequencer



Variations

What else can we do?

- ▶ We're just counting up. Boring. Try rearranging the count wires.
- ▶ Reset and/or reload the counter with input from the counter
- ▶ Reset and/or reload the counter with input from some other oscillators
- ▶ Build another audio oscillator. Modulate it with the sequenced oscillator. Oh my!
- ▶ Make a resistor-controlled amplifier. Sequence volumes!
- ▶ Make a resistor-controlled filter. Sequence filter cutoffs!
- ▶ Make a stand-alone box resistor box

The End

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