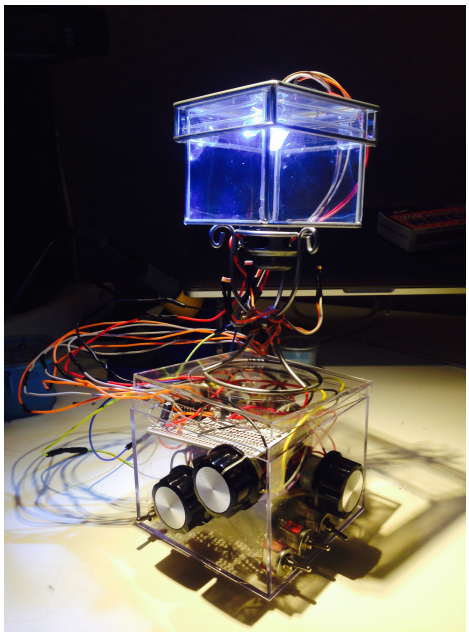
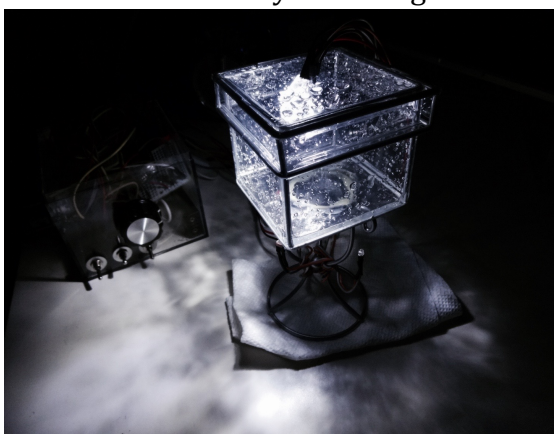
Cymatics Modulation Synthesizer
Akio Mokuno



Overview:
My initial goal was to make a musical instrument akin to an installation in which people can enjoy a visual representation of the music created by reflecting interesting sounds. The concept behind the cymatics modulation synthesizer is that the changes in the lights created from the water patterns modulates the four-cascaded NAND Gate oscillator through photoregisters placed under the water tank. The water patterns are created by another NAND Gate oscillator. I got this idea from looking at the instructions in Nicholas Collin's book when I made the oscillators. I discovered the interesting sounds by adding several photoregisters on the cascaded oscillator. I have been fascinated by how vibrations from the sound, which are frequently of lower frequencies, make patterns on the liquid. Therefore, I decided to experiment with combining these two ideas.



Process:
I spent a significant amount of time making a water vibration speaker system that creates cymatics patterns. To produce strong vibrations, the material used for the case has to be flexible, comparable to a membrane. I experimented with several different materials, including take-out boxes, clear water bottles for pets,

and some plastic boxes found in a container store. I also experimented with a larger square clear case, which was soft clear glued plastic. A small plastic box made with a clear membrane vibrated well, so I decided to use that.

I made the LM386 amplifier, which I connected to the surface bone conducting transducer, using the instructions found in the Collin's book. However, it was not as strong as the other vibration speaker system that I made by combining the parts of the premade products. Therefore, I decided to use the later version of the system.

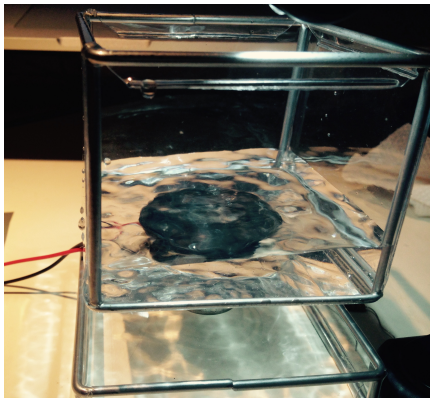


Figure 1

When I experimented with the sounds, the speaker vibrated water extremely (Figure 1) well. However, gluing the speaker to the box fixed the flexibility of the speaker, unexpectedly reducing the number of vibrations being produced. Although it still worked, I had to blast the sound to create water patterns.

For the main synthesizer (four-cascaded NAND Gate oscillator), which is controlled by three photoregisters, I experimented with several different values of capacitors and registers to control the sounds in the suitable pitch register. Then I added two potentiometers to set controls that are more precise.

Instructions:

Supplies needed:

- 2 CMOS Quad NAND Gate Schmitt Triggers (CD4093)
- 3 photoregisters
- X Sticker Portable Vibration Speaker ($8)
- CHACHA Portable Wireless Resonance Vibration Speaker ($13)
- 4 LEDs
- 2 small circuit boards
- Small plastic box with a soft membrane
- Small candle stand (to place the vibration speaker)
- Larger plastic box for the components
- Switches and nobs
- Various registers and capacitors
- 2 9V batteries
- 2 AAA batteries

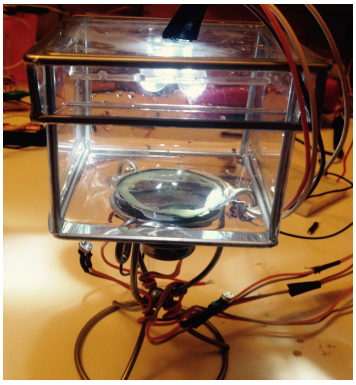
1. Remove the amp circuit from the X Sticker Portable Vibration Speaker. Remove the speaker from the CHACHA Portable Wireless Resonance Vibration Speaker System.

2. Attach the speaker to the clear box (made of a membrane like material). Place the speaker on the small candle stand.

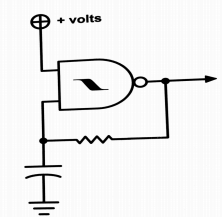
3. Set three white LEDs on the top of the water tank. Solder a 10K register on the positive leg.

4. Extend the legs of the photoregisters by soldering wires and twisting them around on the candle stand.

5. Make the switch for the amplifier by re-soldering + and – on the circuit board from X sticker.



6. Complete the first circuit board using a CD4093 with a 20K register and a 1M potentiometer, as indicated in the schematic below. Then add the switch for it and an LED.



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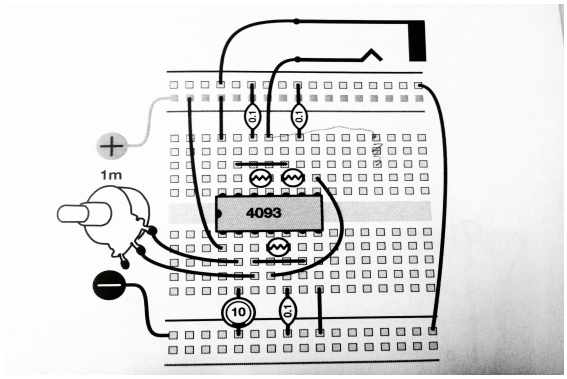
7. For the second circuit board, make a four-cascaded gated oscillator with a CD4093, 20K register, 1M potentiometer, 10K potentiometer, 10uf capacitor, and 22uf capacitor, as indicated in the diagram below. Then add the switches for the LED and the oscillator.



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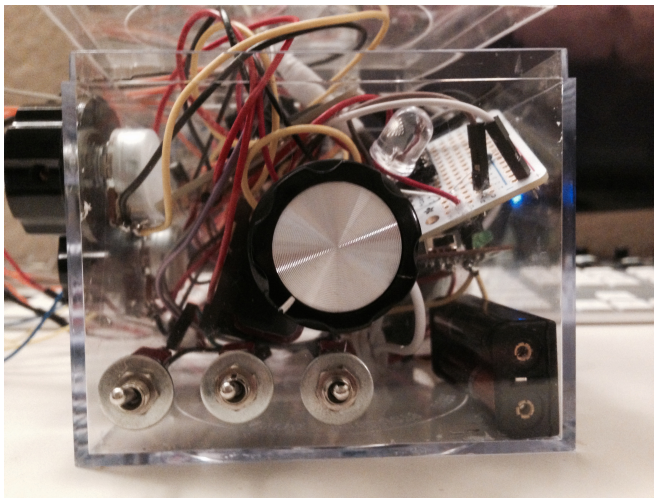
8. Connect the three photoregisters and the LEDs.

9. Put the three circuits in a clear box. Connect nobs on the potentiometers and switches on the surfaces. Then make a 1/4-inch output and a 1/8-inch input.



References:

Collins, N. (2006). Getting messy: Oscillators that modulate each other, feedback loops, theremins, tone controls, instability, clocks for toys, crickets (Chapter 20). In *Handmade electronic music: The art of hardware hacking*. New York: Routledge, 2006.