CHAPTER 25

LCD Art: Making Animated Modern Daguerreotypes and Alternative Video Projectors

You will need:

- A toy (or other expendable device) with an LCD screen.
- Some test leads.
- A 9-volt battery and battery hook-up clip.
- Hookup wire.
- Some straight pins or short needles.
- A basic oscillator circuit from Chapter 18 or 20.
- A flashlight and some lenses.
- If possible, an old-fashioned slide projector.
- Hand tools, soldering iron, and electrical tape.
- If possible, a "video paint-box" toy with video output.
- An amplifier.

LOWER TECH

A lot of handheld toys and games incorporate small LCD screens. In general-purpose LCD displays—such as laptop screens, flat-screen TVs, Gameboys, and cellphones—a matrix of pixels is *bit-mapped* in rows and columns by a microprocessor that turns individual pixels on and off to "draw" any character or image, etch-a-sketch style. In cheap toys, on the other hand, the screen usually contains a handful of "ready-made" graphic components: lips, a nose, and pair of ears are turned on and off against a printed cardboard backdrop to add distinguishing features to Mr. Potato's otherwise generic head, for example. Although this approach severely limits the graphic options of any individual toy, it is much simpler from a programming standpoint, and much cheaper to manufacture.

These rebus-like images take on new meaning when the background is removed—leaving the body parts floating like a medium's apparitions—or superimposed on an alternative drawing or photograph that you provide (Mr. Turniphead? Baby Sister rev. 2.0?). To accomplish this gentle re-purposing, disassemble the toy carefully (don't lose

those tiny screws or tear any fine wires), remove the cardboard backdrop, insert a new one of your choice, re-assemble, and prepare to amuse your friends.

The "narrative" of the game can sometimes be disrupted by shorting various points on the board, as we did in the "Almost a Short Circuit" section of Chapter 15 in pursuit of sonic effects. In some cases injecting an amplified and distorted audio signal can also confuse or modulate the imagery (see page 207 for guidance).

Although fewer in number than the tiny pixels in a bit-mapped pixel grid, these graphic elements are still arranged in a matrix: the toy's computer turns on individual images by sending logic signals through a particular row and column pair. When the screen is removed from the circuit its graphic elements can be activated with simple connections of voltages, either directly from a battery or from an oscillator. Start by tinning the tips of the red and black wires from a 9-volt battery clip to give them stiff, sharp points—you can also solder sewing pins to the wires for stronger, finer contacts.

Locate the connections to the LCD. The glass element is often connected to the circuit board through a thin rubber strip (usually pink, for some incomprehensible reason) containing a thinner strip of black conductive rubber filaments. If you look closely you'll notice that what at first may have appeared as a solid stripe actually resembles a dotted line—each dot is one end of a thread of the same material as those funny rubber hats used as keys on many toys. One end of each of these filaments presses down against a trace on the circuit board, while the other touches a narrow, ghostly grey finger on the edge of the LCD, linking the display to the circuitry. Usually this kind of LCD has connections on two or four edges of the screen. Some older LCDs have larger metal tabs that are soldered directly to the circuit board (as shown in Figure 25.1).

Poke the "+" lead from your battery against a dark point in one rubber strip, and press the ground wire to another point, on the same strip or another. If you remove the rubber strips, you can usually make direct contact with the LCD connections by pressing the wire tip directly to the glass where the rubber sat, or by clamping the jaws of a narrow clip lead to the edge of the glass. Look carefully: you should be able to see very fine lines etched on the glass—these are the electrical contacts. Move the probe or jaws along the edge and catalog the hot spots for the individual screen elements. If the screen has more substantial metal connections poke them directly (see Figure 25.1). Keep trying different pairs of contacts while watching the screen—at some point an LCD

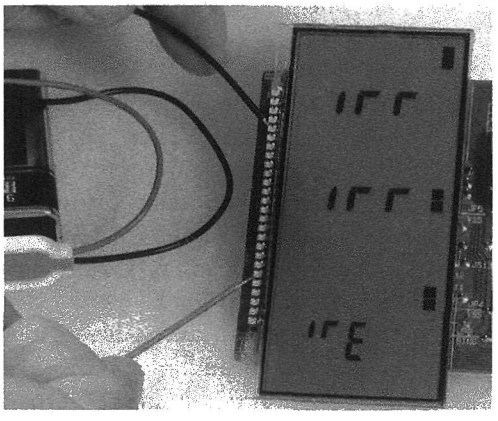

Figure 25.1
LCD elements being activated by direct battery connection.

element should become visible. Make a note of the location of the contact point pairs that enable specific graphic objects, and keep exploring. Once you find a set of images that you like, you can make the connections more stable by wedging and taping wires or pins into or against the contact strips.

You can *animate* the images by using the outputs of oscillators to blink the LCD elements instead of setting them "permanently" on with battery leads. Breadboard a simple oscillator with a 74C14; use a larger capacitor (2.2–10 uf) and a big pot so it runs at a low, metronomic speed. Take one lead from the output of the oscillator and one from the circuit ground (battery "–"). Connect the leads to points along the LCD edges that you know enable images (see Figure 25.2). Adjust the oscillator speed and watch the LCD element turn on and off. If nothing happens, swap the oscillator output and ground connections to the LCD, or try different contact points. Continue to connect more oscillators to more contacts until you achieve the visual texture you want. When more than one oscillator is connected you can usually remove the ground lead from your circuit and just use oscillator outputs—the interaction amongst low and high outputs of the various oscillators activates the matrix. Alternatively you can connect jumpers between any electronic circuit (such as a bent toy) and contact points on a device containing an LCD screen and search for interesting modulation effects (see Michał Dudek's video on the DVD).

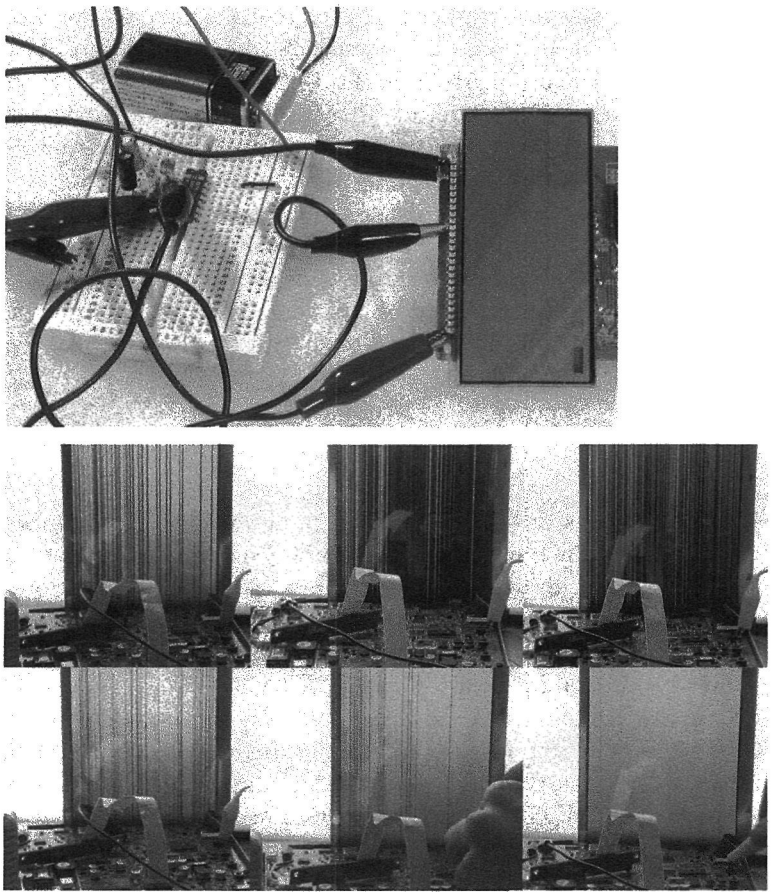

Figure 25.2
LCD elements animated by oscillator outputs.

LCDs are kind of spooky—the image often lingers on the screen for several seconds after power is disconnected before fading out. The small screens bear a resemblance to old daguerreotypes (although Berlin artist Martin Riches reminds me that daguerreotypes had resolution so fine as to be discernable on a molecular level, in stark contrast to the crude pixilation of an LCD). They have a certain charm as modern miniatures, whether superimposed on new backdrops or left in their rather ghostly, mostly transparent state as tiny digital stained glass windows. They are lovely hung in a sun-dappled window.

The current consumption of the LCD device and a low-frequency oscillator is so small that you can leave the object running on a 9-volt battery for weeks before it runs down. You could even power the whole thing with a small solar panel (especially if you *do* choose to hang it in a sunny window). If you go shopping for the latter, look for one that puts out anywhere from 3 to 12 volts, with a current capacity of 5 milliamps or greater. Some CMOS and LCD circuits can even be powered by a battery made from an apple or potato. So dust off those childhood science fair notes or skip ahead to Chapter 29 for some alternative energy sources.

With a decent light source and the appropriate lens you can project your LCD onto a wall—experiment with flashlights or bright LEDs and some lenses. Invest in one of those "third hand" devices: use the two articulated arms with alligator clips to hold the LCD and a lens to focus the image projected by a narrow-beam table lamp. You'll have to remove any printed backdrop, of course, and some LCDs without a background picture use a simple self-adhesive reflective tape that must be peeled off to make them transparent.

You can also drop the LCD screens from tiny portable "stadium TVs" into older slide projectors (see section on BMBCon in Art & Music 10 "Visual Music," Chapter 24). The screens of many older mini-TVs fortuitously have the same dimensions as a 35 mm slide. You can do the same with the displays from many cheap hand-held games—the stupidest thumb-driven hockey match looks pretty cool projected huge, upside-down and slightly fuzzy on a wall. LCDs can be damaged by excessive heat—it helps to add additional fans to cool the slide-well in the projector.

Don't let the visual charm of LCDs distract you from their sonic potential. Clip the ground half of an audio cable to the battery ground of a working LCD toy (before you do the hacks described above) and touch the hot lead to the various scan lines of the LCD display: you often hear deep, rich chords.

HIGHER TECH

Several companies specializing in high-end electronics toys, most notably V-Tech, make "video paint boxes" for children. These devices connect to a television and include a simple graphics tablet and keyboard with which the kid creates drawings and animations. Inside are some very sophisticated graphic chips that can be bamboozled into doing strange things. Following the technique described in Chapter 15, use wire or clip leads to interconnect any points on the circuit board. Occasionally you will get lucky and find connections that cause the graphics engine to freeze mid-way through drawing an image, re-color blocks of pixels, superimpose graphics from its memory, etc. Since these circuits usually use crystals for their clocks, any clock speed modification will probably require replacing the crystal with CMOS oscillator, as we discussed in Chapter 20. And while you're at it don't forget to listen to different points on the board as well. (See Art & Music 10 "Visual Music," Chapter 24.)

PART VI

Finishing