Chapter 25

# VIDEO MUSIC/MUSIC VIDEO: TRANSLATING VIDEO SIGNALS INTO SOUND, HACKING CHEAP CAMERA CIRCUITS, AND EXTRACTING SOUNDS FROM REMOTE CONTROLS

You will need:

- A video camera or camcorder.
- A video monitor.
- Photoresistor-controllable oscillators.
- A cheap, hackable CCD video camera circuit board (see text).
- A phototransistor.
- A photoresistor.
- An infrared remote control from a TV or other appliance.
- An audio amplifier.
- Some speakers.
- Some small mirrors, a laser pointer or flashlight.

Various ingenious software tools exist for translating pictorial data into sound and vice versa: Soundhack's "Open Any…" turns any computer file into a sound file (i.e., a Photoshop-to-hit-record converter), STEIM's "Big Eye," and Max's "Jitter" track moving objects in a video image and extract MIDI or audio information. But here are a few simple hardware approaches to the same problems that bypass the computer.

## Light and Shadow

Several artists have translated images directly to sound by placing photoresistors on video monitors or projection screens (see "Visual Music"). Wire up a few photoresistor-controlled oscillators (see chapter 18). Place the sensitive side of a photoresistor against the screen of a video monitor and use a thin strip of opaque electrical tape across the back to hold it in place; repeat for each photoresistor, distributing them across the screen. Hook up a camera or play back a tape. Action! Instant soundtrack! You can do this on a projection screen as well.

You can also use the photoresistors to adjust the loudness of any audio signal (CD, tape, microphone, etc.) in response to fluctuations in the image, by adapting the gating and panning circuits from chapter 22 to work with photoresistors affixed to a monitor or projection screen.

## Frame Rate Music

Connect the analog video output of a camera to an amplifier and speaker—that's right: the *video* output to the *audio* input (the camera puts out a video signal that is about the same level as a CD player). Pan the camera around the room as you listen. You should hear a steady drone whose overtones fluctuate in response to the image content and brightness. The fundamental pitch is a function of the video frame rate (NTSC or PAL-specific), and therefore unwavering if the camera is functioning normally, while the overtone balance directly represents the image data, line by line. Very nice, if you like drones.

Aim the camera through a rotating fan; vary the fan speed and you may hear interference patterns between the frame rate and the fan speed. Focus on a white card off-center on a black turntable mat, and switch between 33 and 45. Aim the camera at the monitor and look and listen as you experiment with video feedback. A video mixer, keyer, or special effects box introduces audible artifacts as well as visible ones. Aim an IR remote at the camera (most video cameras detect infrared light and show it as hot white) and listen to the burst pattern of the encoded data (see Channel Surfing Music below).

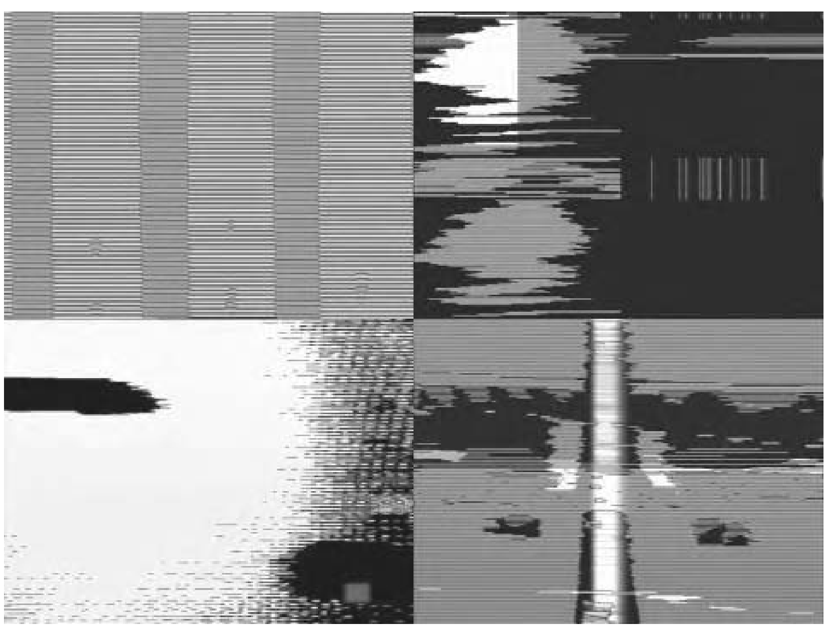
The frame rate is fixed, and normally doesn't budge unless you move between NTSC and PAL. But if you invest in a cheap black and white CCD camera circuit board (scrounged from a surveillance camera, or available from most electronic surplus outlets for less than $25.00), you can experiment with tickling the clock frequency by a laying of hands (as we did in chapters 11 and 12) or replace the clock crystal with a variable oscillator (as discussed in chapter 21). The crystal is usually pretty conspicuous on the circuit board—often a metallic silver small cylinder or block (see figure 25.1).

**Figure 25.1** Camera board with switch for disconnecting crystal (circled, right) and electrodes for tickling clock frequency (left, visible below switches).

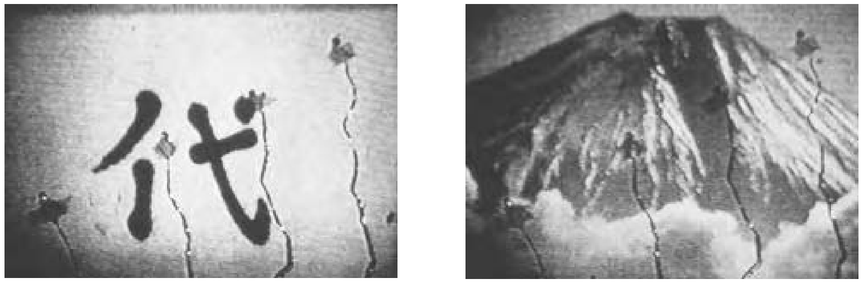
***Visual Music***

Electronics have pervaded and altered our visual world as profoundly as our sonic one and, furthermore, allowed us to link the two in peculiar, causal ways. In his 1965 work "Magnet TV," Nam June Paik sat a large magnet on top of a television set to distort its image; although technically rather crude, this piece presaged the considerably more "sophisticated" electronic image processing that would come to typify much subsequent video art. "Magnet TV" established a hacker precedent that would remain a consistent presence in Paik's work, as well as in that of many multi-media artists who followed him. Before lightning-fast personal computers with massive amounts of memory made digital video processing as commonplace as word processing, Paik-like hacks were the only affordable way to manipulate visual images in real time, or to create linkages between video and audio. Video feedback was as common a tool for early video artists as audio feedback was for electronic music composers: Bill Viola (USA) made extensive use of it in the 1970s; more recently Billy Roisz (Austria) VJs with video feedback, modifying it through simple video mixers and keyers, and splitting the video signal to feed the PA as well, so that the bursts and jitter of the images are heard in parallel as glitches and hums (see figure below).

"Cloud Music" was a video/music installation developed by David Behrman, Bob Diamond, and Robert Watts between 1974 and 1979. In the earliest version, a camera was pointed at the sky and connected to a video monitor. A number of photoresistors were affixed to the screen. The light values of the passing clouds changed the resistance of the photoresistors, and, in turn, affected the sound score. Yasunao Tone (JP/USA) used a similar approach in his "Molecular Music" (1982–85): photoresistors were taped to the surface of a screen onto which a film was projected; each photoresistor controlled the pitch of an oscillator (similar to



Four stills from video feedback performance by Billy Roisz.

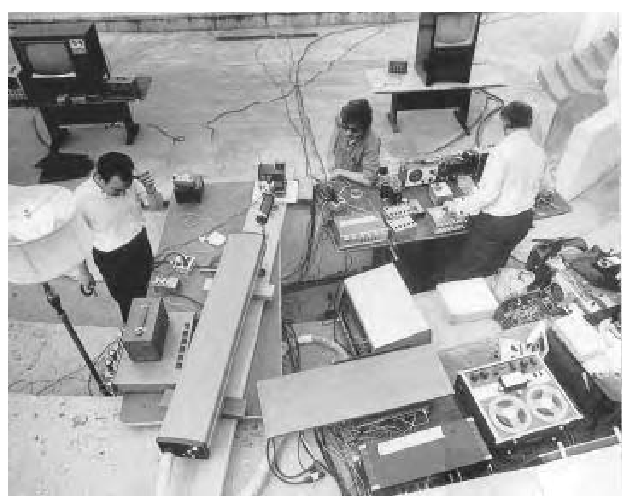



Two stills from "Molecular Music," Yasunao Tone.

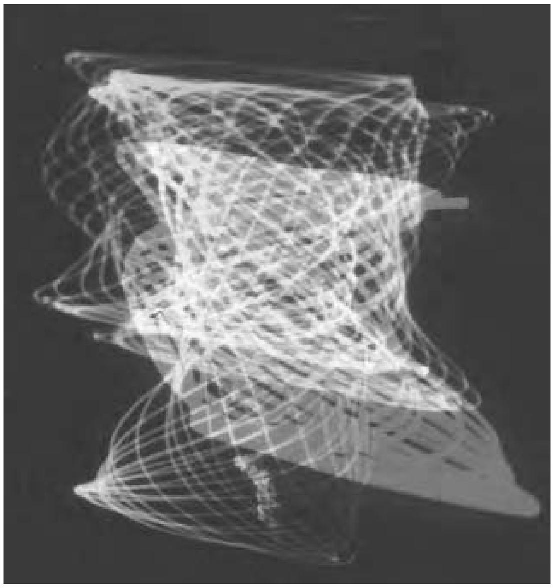
those described in chapter 18), and the resulting sound mass responded directly to the change in projected images (see figure above). Today, Tone is best known as the "grandfather of glitch": he began "wounding CDs" in 1985 by applying Scotch Tape punctured by pinholes to the underside of the disks; the resulting frenetic digital error-fest was the first documented music made with intentionally damaged CDs (see track 20 on the CD). The intertwining of light and sound are central to Tone's work: the deflection of lasers through pinholes is a miniaturized, but nonetheless logical, extension of film interrupting the projector's light before it strikes the photoresistors.

In 1969, long before planetarium laser shows, Lowell Cross (USA), a frequent collaborator of John Cage and David Tudor, created the first sound-modulated laser projections for his work "VIDEO/LASER II": the laser (enormous at the time—see figure below and top of next page) was reflected off a mirror mounted on a speaker-like device called a galvanometer, which vibrated in response to sound input to create curving Lissajous patterns on the wall. (Lowell Cross also built a beautiful photoresistor-based matrix mixer embedded in a chessboard for the famous 1968 John Cage/Marcel Duchamp chess-playing performance, "Reunion").

In 1999, when Stephen Vitiello had an artist's studio on the ninety-first floor of the World Trade Center in New York City, he and Bob Bielecki (see "The Luthiers," chapter 29) hooked up a photoresistor to a battery (as shown in figure 25.6), placed it on the eyepiece of a telescope, aimed it down at New Jersey, and



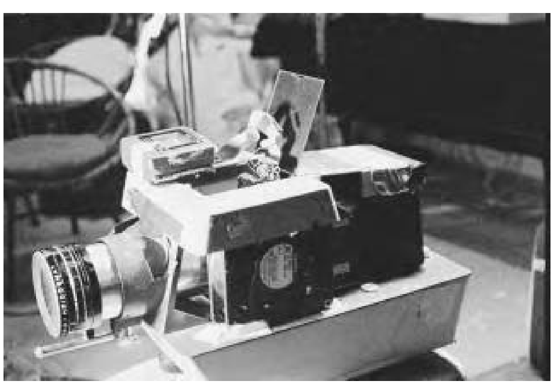
Lowell Cross (L), Eugene Turitz (C), and David Tudor (R) setting up for the first laser light show to use *x-y* scanning, Mills College, Oakland, California, May 9, 1969.



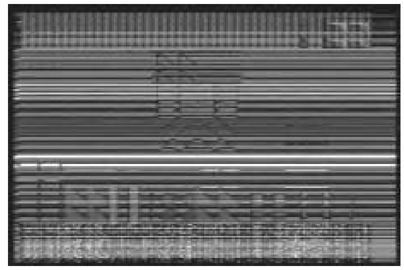
Laser projected image from "VIDEO/LASER II" (December 1969), Lowell Cross.

sat together listening to the flashing lights on a police car across the Hudson. Vitiello has made a beautiful series of recordings using this "audio-telescope" (see track 18 on the CD). Norbert Möslang, ex-Voice Crack (see "Composing Inside Electronics," chapter 14), has used similar circuits to extract surprisingly rich rhythmic and harmonic textures from the light patterns of bicycle flashers and LEDs on toys (see track 19 on the CD).

Computers finally caught up with video, but visual hacking hasn't stopped. The disparity between the $100-portable LCD TV and the $5,000-video projector offended the sensibility of the Dutch electronic performance trio BMBCon (Justin Bennett, Wikke 't Hooft , and Roelf Toxopeus), so in the mid-1990s they took the screens from cheap TVs (which have the same dimensions as 35mm slides) and dropped them into old slide projectors from the flea market—voilá: the home-made, low-budget video projector (see figure below). Jon Satrom (USA) has built his VJ career on transforming a child's "video paint box" into an instrument he calls the "Vitch" (see figure top of next page). By inserting Circuit-Bending-style jumpers between various points on the circuit board, Satrom is able



Homemade LCD projector, BMBCon.



The "Vitch," Jon Satrom (left). Video image from performance with the "Vitch," Jon Satrom (right).

disrupt the toy's functions to produce a remarkable range of fragmented, frozen, superimposed, and digitally warped images (essentially a video equivalent of the keyboard malfunctions described by Phil Archer in "Circuit Bending," chapter 15). And in a pseudo-Victorian twist that would make John Bowers proud, Dutch artists Remko Scha and Arthur Elsenaar attach electrodes to Elsenaar's face and electrically stimulate the muscles of expression to provide an "emotional display" for their computer.

Split the camera output between a video monitor and amplifier, so you can *see* as well as *hear* the affect of your hack. Sometimes lifting one leg of the camera's crystal time base makes it just unstable enough to produce a coherent image when left alone, but jitter like crazy when touched. You may be able to make an oscillator whose pitch is controlled by a pot, photoresistor, etc., and whose timbre is a function of what it sees. The video image produced by a tickled camera is reminiscent of 1960s 8mm film "scratch animation", and the sound is somewhat meatier than the typical hands-upon-radio swoops.

**USE A BATTERY-POWERED VIDEO MONITOR AND AMPLIFIER IF AT ALL POSSIBLE TO MINIMIZE THE RISK OF ELECTROCUTION. IF THIS IS NOT POSSIBLE, APPROACH THIS EXPERIMENT WITH *EXTREME* CAUTION.**

The hacked camera will not generate a stable sync signal when tickled. Most video monitors will continue to display scratchy video in the absence of a stable sync, but many video projectors are too "smart": they will interpret intermittent sync as a sign that there is no video signal at all, and will display that irritating blue screen with the legend "no video input." Providing a proper sync under scratch video is beyond the scope of this book, sorry—use an old TV instead, or patch your hacked camera through a video mixer or other device that can restore the sync.

As long as we are on the subject of old TVs, I would be remiss if I did not remind you, the reader, of the beautifully liquid image distortion that results from putting a hefty magnet in close proximity to a television picture tube (ineffective on modern LCD screens). Take an old TV. Tune it to any station or even inter-station static. Move a big

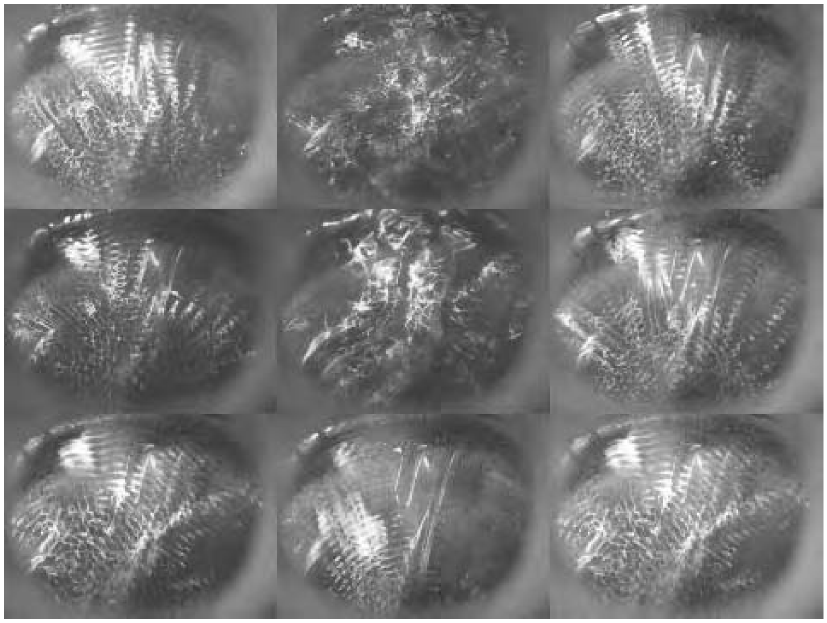


**Figure 25.2** Water-filled speaker, showing ripples produced by low-frequency sound.

magnet over the top and sides, and watch the image wiggle—a gift from Nam June Paik (see "Visual Music").

## Video-Free Video

Visual display of sound patterns can be accomplished without video cameras and monitors, of course. As we described at the end of chapter 5, you can take a large raw loudspeaker, fill it with sand or talcum powder, connect to an amplifier, play some sound, and watch the dancing dust. Coat the inside of the cone with paint or rubber cement, fill it with water or oil, and repeat the experiment; you can reflect a focused light or laser pointer off the water's surface onto the wall or ceiling (see figure 25.2). A mirror glued to the center of the cone also reflects a laser nicely.

## Channel Surfing Music

In chapter 3 we used coils to pick up the electromagnetic signals given off by various appliances and electronic devices. We can also eavesdrop on light signals of various kinds by using a specialized type of photosensor. The "phototransistor" is the heart of any infrared remote control receiver circuit, such as that in your TV. It detects the pulses of infrared light sent by your remote control and converts them into a stream of binary pulse waves that are, in turn, translated back into digital data by the microprocessor in the TV. Earlier in this chapter we detected these data burst using a video camera, but there are cheaper methods.

Aim a remote control at the simple circuit in figure 25.3 (keep it close) and you should hear pulse trains as you press the buttons. If not, reverse which leg of the phototransistor connects to +9 volts and which connects to the load resistor. The differences between one

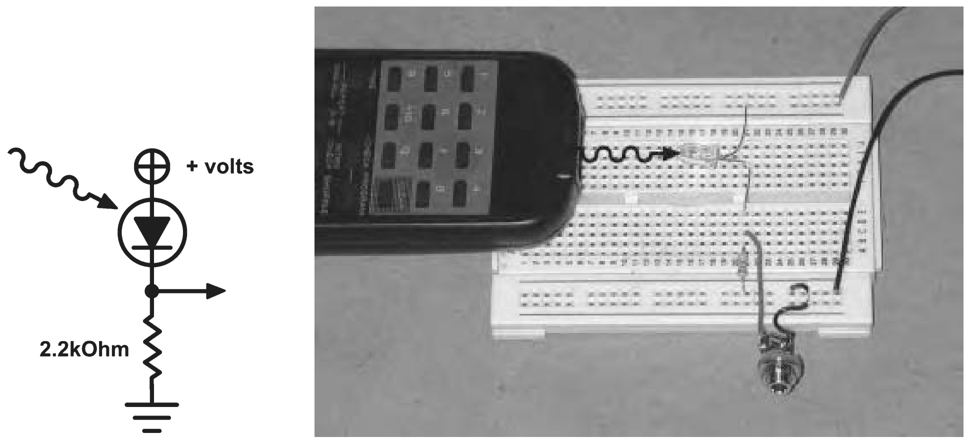



**Figure 25.3** Simple infrared detector circuit.

button and another may sound pretty subtle, even though the encoded data is different. Try different remotes—the fundamental frequency and basic timbre may differ from one to another, but it might be a subtle difference, since they're all sending similar pulse trains. You'll notice that the loudness of the signal falls off pretty sharply as you pull the remote farther from the circuit, so you do have some dynamic control over this instrument.

You can substitute an ordinary photoresistor for the phototransistor; you may need to increase the size of the load resistor from 2.2kOhm to 10kOhm or larger, as shown in figure 25.4. Because photoresistors are sensitive to light across the spectrum (not just infrared), you will get much more interference from the power grid's AC frequency present in incandescent and fluorescent lighting (60hz in the United States, 50hz in Europe),resulting in an underlying drone. But you may find this interesting rather than irritating, so try it.

Since the lights on many electronic circuits look steady but are in fact "scanned" by the central processor unit, you can use these circuits to extract unexpected sound patterns from almost any device with LEDs. Try it on bicycle flashers (see track 19 on the CD), toys with blinking lights, the front panels of studio gear, TV screens, computer monitors. Sometimes bicycle lights and blinking toys sound astonishingly much like heavy metal chord progressions.

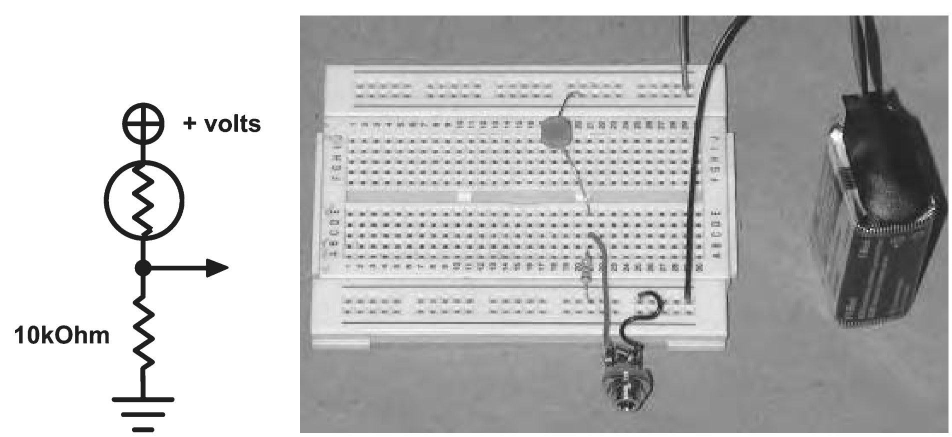



**Figure 25.4** Simple photoresistor light-to-sound converter.

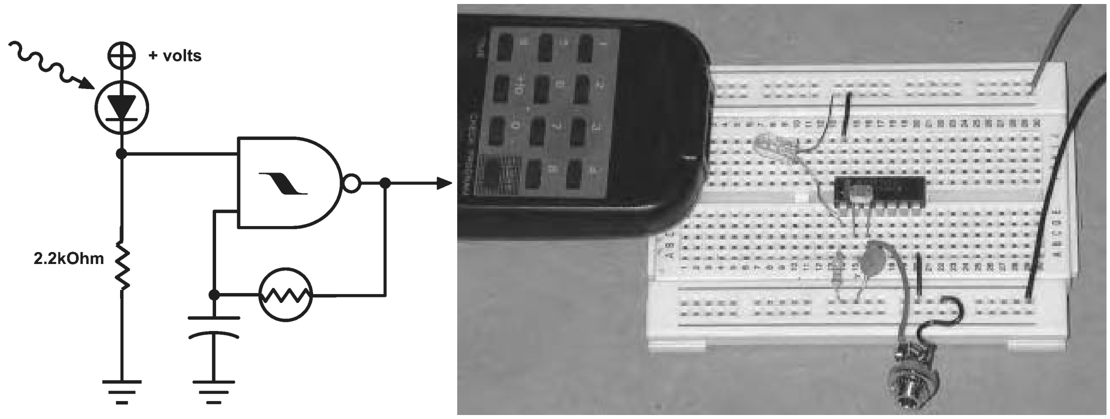



**Figure 25.5** Infrared-gated oscillator with photoresistor-controlled frequency.

If these pulsey or hummy sounds get too dull, try using the phototransistor or photoresistor circuit as the control input to the basic 4093 gateable oscillator circuit from chapter 20. If you use a photoresistor for the oscillator's frequency control resistor, you get a pretty expressive "multi-phase" light-to-sound converter that responds to both ambient and modulated light sources (such as remote controls) (see figures 25.5 and 25.6).

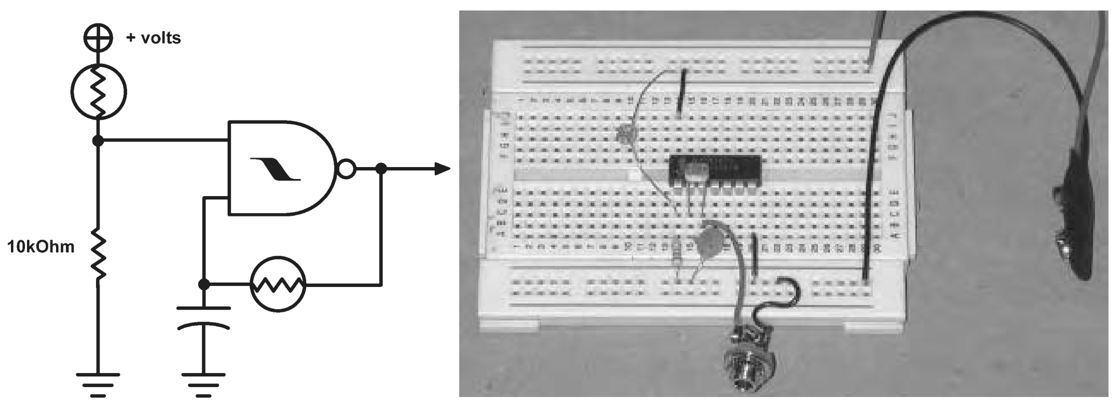



**Figure 25.6** Photoresistor-gated oscillator with photoresistor-controlled frequency.