THIS MONTH'S PROJECTS

LEVEL RATING SYSTEM

To find out the level of difficulty for each of these projects, turn to our ratings for the answers.

●○○○ . . . . Beginner Level

●●○○ . . . . Intermediate Level

●●●○ . . . . Advanced Level

●●●● . . . . Professional Level

Friends, birders, electronics enthusiasts, lend me your ears so that you may listen to faraway sounds using these easily built long-range stereo microphones.

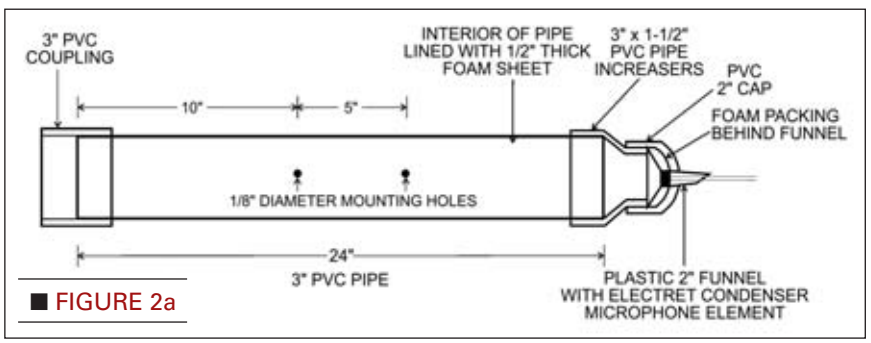
(with apologies to William Shakespeare and Mark Anthony)

LONG-RANGE STEREO MICROPHONES

A readily available Velleman "Super Stereo Ear" Mini Kit, or manufactured "for the hard of hearing," microphone/amplifier assemblies, plus some PVC tubing, foam inserts, a few pieces of wood, and a handful of nuts, bolts, and volts is all that is needed to build a stereo microphone system that lets you pick up distant acoustic signals with clarity and accuracy.

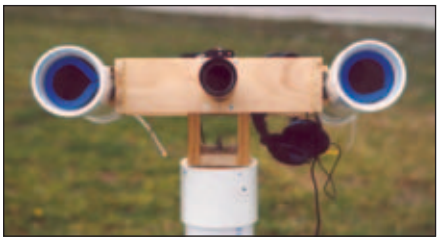
Using electronics to listen in on birdcalls or other distant sounds is not a new undertaking. I used the guidelines given by Charles D. Rakes in his December 2002 *Poptronics* article, "An Ear to the Outside World" (pp. 55-58), to construct the long-range microphones presented in this article but with one big difference — my design incorporates a dual microphone system so that the listener can hear in stereo. I find that using two microphone/amplifier systems (one for each ear) placed at spacings of two to three times the normal ear-to-ear

■ FIGURE 1. Three views of "Big Mike" showing the arrangement for the two 24-inch microphones fastened about 18 inches apart on a simple altazimuth mount. The center tube is an optional Galilean telescope.

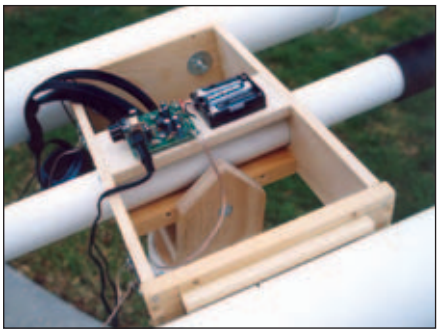


■ FIGURE 2a

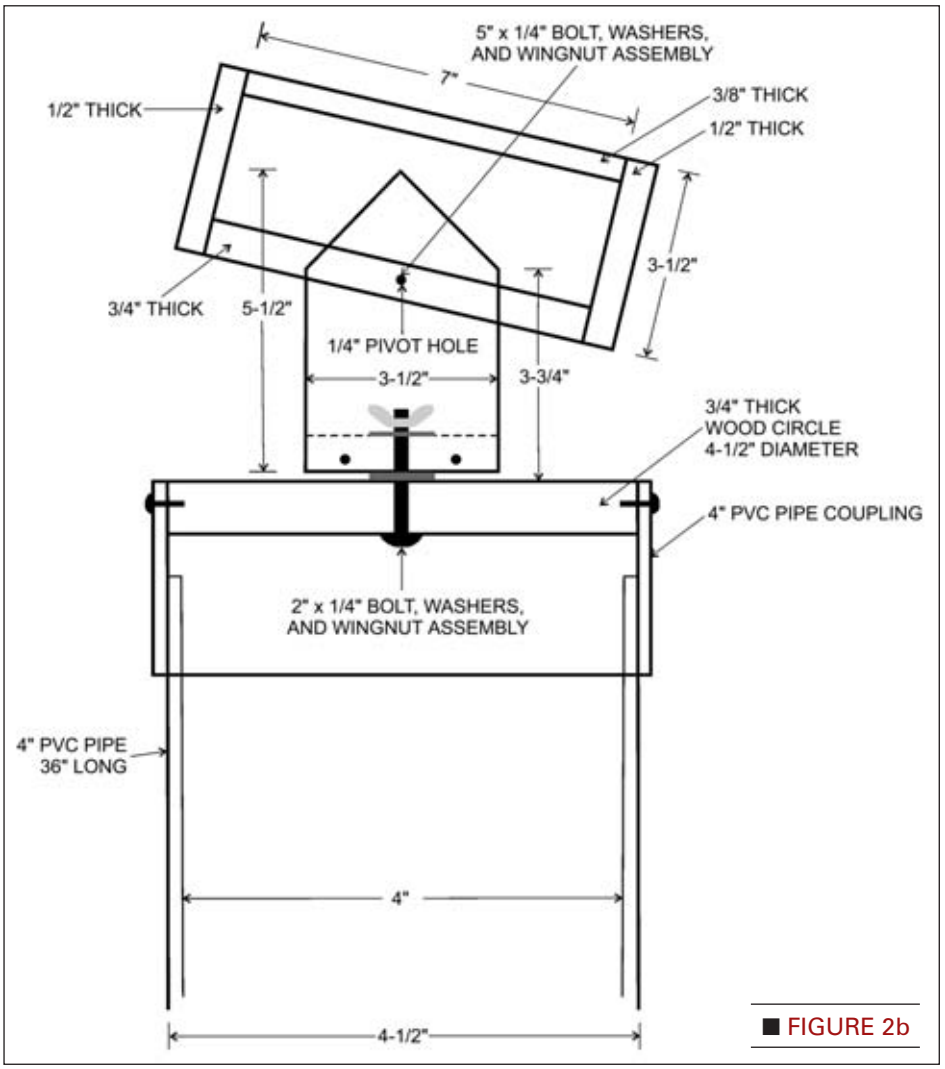
■ FIGURE 2. Construction details and dimensions for the microphone tubes and mount: (a) Microphone tube; (b) Interior section of the altazimuth mount; and (c) Front of altazimuth mount.



■ FIGURE 3. Front view of the microphone tubes showing the plastic foam inserts (blue) used as sound dampening material.

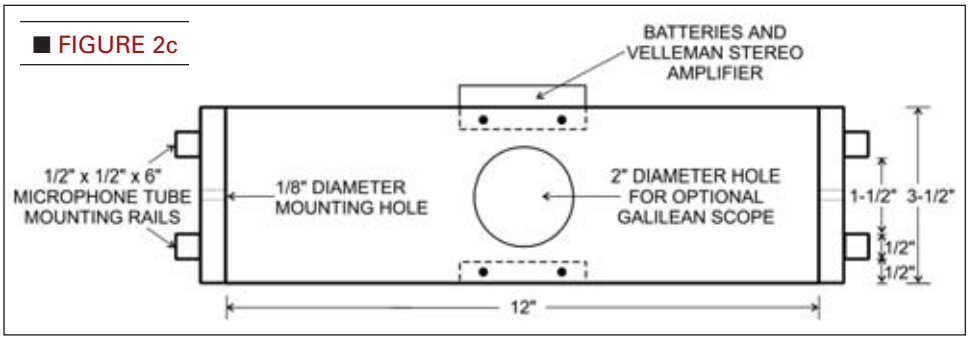


■ FIGURE 4. Placement of the battery holder for three AA batteries and of the Velleman "Super Stereo Ear" printed circuit board is visible, along with a close-up look at the altazimuth mount construction.



■ FIGURE 2b

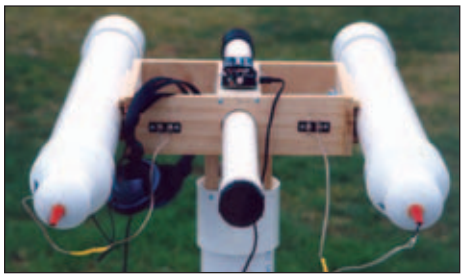
■ FIGURE 2c



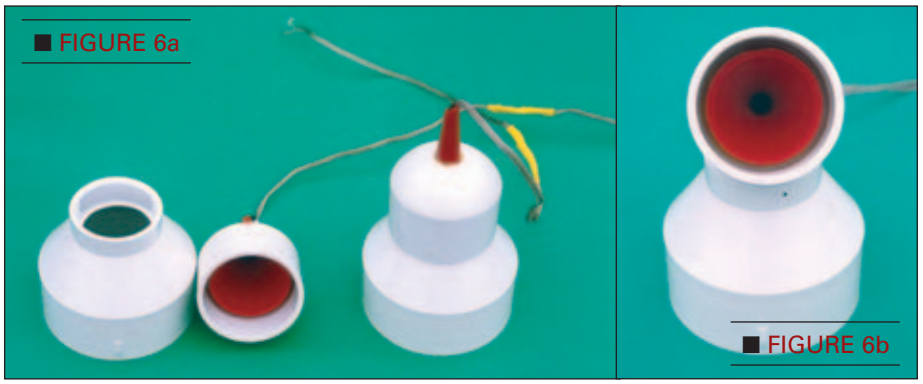
distance (about 6-7 inches for an adult) enhances the listening experience in terms of sensitivity to nearly inaudible sounds and sensitivity to direction. I constructed two systems. One system, which I call "Big Mike" (see Figure 1), follows more closely the instructions given by Rakes for creating a mono, long-distance mic. Figures 2a, 2b, and 2c show the details for constructing "Big Mike." I had a hard time finding thin sheets of foam rubber to act as sound insulating material and instead cut up a plastic foam camping mattress that was about half an inch thick (see Figure 3).

The microphones are sensitive electret elements that are part of the Velleman kit MK136 "Super Stereo Ear," which is ideal for this project. Figure 4 shows the placement of the stereo amplifier and the battery holder on top of the wood mounting platform. Figure 5 shows where the electret microphone elements — glued inside orange plastic funnels — are located in order to channel the sound at the end of each tube. Close-ups showing details of the microphone element-to-funnel assemblies are shown in Figure 6.

The two 3 x 24 inch PVC tubes with insulating foam and end caps weigh about 10 lbs. I found it necessary to attach them to a crude (but effective!) wood altazimuth mount



■ FIGURE 5. Back of the microphone tubes showing the hookup wires for the electret elements exiting the orange funnel stems sticking through the two inch PVC end caps. Gorilla Glue was used to glue the funnels in place and Goop was used to glue the two-inch PVC end caps to the 3 x 1-1/2 inch PVC pipe increasers.



■ FIGURE 6. Close-up views of the funnel/microphone/end cap assemblies. (a) Left end-cap unassembled; right end-cap in final configuration. (b) Close-up of funnel in end-cap; the electret element has been glued into place about 1/2 inch down the exit throat of the funnel stem.

"BIG MIKE" PARTS LIST

QTY	ITEM/DESCRIPTION
❑ 2	24 x 3 inch PVC pipes
❑ 2	3-inch PVC hub-to-hub couplings
❑ 2	3 x 1-1/2 inch PVC hub-to-hub pipe increasers
❑ 2	Two-inch PVC soc caps
❑ 2	Two-inch diameter funnels from set obtained at American Science & Surplus (**www.sciplus.com**), part number 91078 (You will need to order two sets of four funnels to get the two funnels you need — these are hard to find and this set is inexpensive @ $1.75 per set.)
❑ 2	1/2 x 24 x 8 inch pieces of foam camping mattress pad or any other similar material suitable for sound dampening
❑ 1	36 x 4 inch PVC pipe (pier)
❑ 1	Four-inch PVC hub x hub coupling (pier)
❑ 1	Four-inch PVC hub closet flange (for base of pier)
❑ 1	Velleman MK136 "Super Stereo Ear" mini kit ("boosts sound 50 times")
❑ 1	Stereo headphone

Miscellaneous wood boards, hardware, and glue

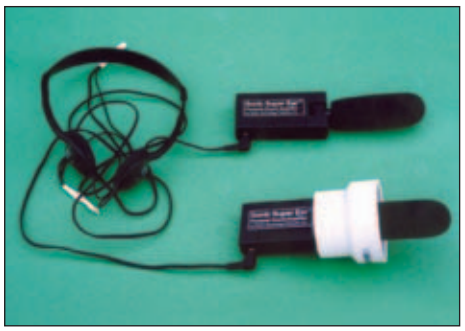
(see Figure 4) using four-inch PVC pipe as a pier. The optical telescope in the middle between the two mics is not necessary, but if you are looking for an excuse to make and use a Galilean telescope (which provides a correct, right-side-up view), this is a reasonable construction opportunity. The catalog from Anchor Optical Surplus (**www.anchoroptical.com**) has instructions for building a Galilean telescope with lenses you can order from them.

A second, smaller system, based on the same principles as Big Mike, was constructed as a handheld unit (Little Mike) and is shown in Figure 7. This project makes use of readily available components and a small wooden mount that requires only a little cutting and gluing. The two microphone/amplifier assemblies (see Figure 8) are the type you find in household gadget catalogs with names that include "Sonic" and "Super Ear." They work quite well, but the earphones accompanying them are wired for mono listening with the single microphone/amplifier.

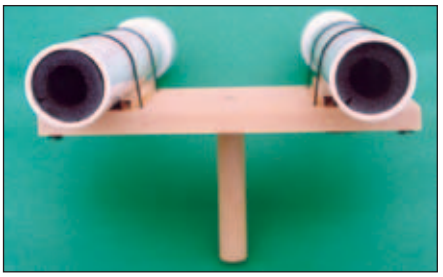
A little cutting and soldering will allow you to connect the left earphone to one microphone/amplifier and connect the right earphone from the same headset to the other microphone/amplifier so you can listen in stereo. And yes,

■ FIGURE 7. Photo of "Little Mike" constructed from two 13-inch long, two-inch diameter PVC microphone tubes mounted nine inches apart on a 12 x 5-1/2 x 3/4 inch wooden platform using 1/4 x 1/4 inch mounting rails and cable ties.

■ FIGURE 8. Pair of "Sonic Super Ears" used for the microphone/amplifier systems. The plastic case of one of the microphone/amplifier systems is shown cemented into a 2 x 1-1/2 inch PVC pipe increaser using Gorilla Glue.



■ FIGURE 9. Rear view of "Little Mike," showing the two-inch outside diameter polyethylene foam pipe insulation inside the PVC tubes. The microphones with foam covers (see Figure 8) fit nicely into the 1-1/4 inch inside diameter core of the polyethylene foam pipe insulation inserts.



since you bought two complete microphone/amplifier systems, you have one headset left over — think of it as a spare.

The two PVC pipes used to house the microphones are, fortuitously, slightly greater than two inches inside diameter and will nicely accommodate the polyethylene foam-pipe insulating material that is two inches outside diameter (see Figure 9). This makes for easy construction; simply cut off an appropriate length of the two-inch PVC pipe (you can try longer lengths than the 13-inch length I used with perhaps better results) and then cut off the same length of the polyethylene foam-pipe insulation and insert it into the PVC tube.

The microphones, which have their own black foam cover, fit exactly into the inside diameter of the polyethylene foam insulating tube. I used 2 x 1-1/2 inch PVC pipe increasers as end pieces so I could glue the amplifier housings onto them to make rigid assemblies that could be placed at the end of the PVC pipes. I did not glue the microphone/amplifier/pipe increaser units to the end of the PVC pipes, but simply used a press fit, which turned out to be very snug and won't come apart unless you tap them lightly with a small hammer.

I used a 12 x 5-1/2 x 3/4 inch wooden platform and plastic cable ties to fasten the PVC microphone/amplifier assemblies nine inches apart. A six-inch long, one-inch-diameter dowel attached to the underside of the wooden platform acts as a handle. This system, although much lighter than Big Mike, weighs about 3-1/2 lbs. and can be tedious to hold for long periods of time. A four-foot by one-inch PVC pipe, with a 1-1/4-inch rubber chair tip to act as a foot at one end, can be used as a monopod — just slip the one-inch-diameter dowel handle into the pipe opening (the dowel handle visible in Figure 9 is shown mounted in the monopod pipe in Figure 10), and you can effortlessly aim the microphones anywhere you want.

Both setups work well and have advantages and disadvantages. There are obvious differences in transporting ease and handling ability, due to size and weight. Big Mike is more sensitive to direction but is also noisier. Little Mike has two separate amplifiers with separate volume controls, which may be useful if you are more hard of hearing in one ear compared to the other, but it does take a few seconds to balance the sounds. In any case, they are certainly fun to use, and they do attract a crowd! **NV**

■ FIGURE 10. Rear view of "Little Mike" with microphone/amplifier/PVC pipe increaser assemblies attached to the PVC tubes.

"LITTLE MIKE" PARTS LIST

QTY	ITEM/DESCRIPTION
❑ 2	13 x 2 inch PVC pipes
❑ 2	Two-inch PVC hub-to-hub couplings
❑ 2	2 x 1-1/2 inch PVC hub-to-hub pipe increasers
❑ 2	13 x 2 inch diameter polyethylene foam pipe insulation jackets for steel and copper pipes (You will need to measure the outside diameter and inside diameter of this material at the hardware store — depending on the brand, they can vary considerably in size even though they are meant for fitting the same size pipe.)
❑ 2	Microphone/amplifier systems that go by the trade name of Sonic Super Ear (A search on the Internet using the trade name will produce a number of sites — check out all sites as prices vary considerably.)
❑ 1	48 x 1 inch PVC pipe (for monopod)
❑ 1	1-1/4 inch rubber chair tip (for monopod)
Miscellaneous wood boards, hardware, and glue	