Electric Thrush

by rabbitcreek

Sitting on the deck in late evening I was truly amazed at the resonant call of a tiny bird sitting on a bare twig at the top of a distant birch tree. The call is amazingly potent to the ear. It belongs to a family of unique singers -- thrushes. This one was a Hermit Thrush. Their songs have been characterized as "the voice of the cool, dark, peaceful solitude which the bird chooses for its home." This group includes: Varied, Wood, Hermit, and Swainsons. Up in Alaska it's been called the Salmonberry Bird on the northwest coast when it appears during berry season.

The unique organs that allow such a tiny bird to broadcast its voice so far is amazing. More recently the loudest bird call ever recorded--comparable to a pile driver or howler monkey in intensity--has been documented as the mating call of the White Bellbird. Doing justice to an electronic facsimile of this voice is the origin of this project. This solar powered Electric Thrush uses an SD card of bird calls from the Cornell Lab of Ornithology as .WAV files and randomly plays them when a PIR sensor detects something warm with ears going by.


https://youtu.be/rnUjh0kQ0AE

Step 1: Gather Your Materials

Solar panels, amps and something that will play wav files are your basic building blocks. You can substitute for any and all but theses sizes and setup work with this 3D print.

1. Uxcell 2Pcs 6V 180mA Poly Mini Solar Cell Panel Module DIY for Light Toys Charger 133mm x 73mm $8

2. Audio Amplifier Board, DROK 5W+5W Mini Amplifier Board PAM8406 DC 5V Digital Stereo Power Amp 2.0 Dual Channel Class D Amplify Module for Speaker Sound System DIY $13

3. AIYIMA 2pcs Subwoofer 2 inch 4ohm 5w Full Range Speaker Mini DIY Audio Subwoofer Loudspeaker $6

4. DIYmall HC-SR501 Pir Motion IR Sensor Body Module Infrared for Arduino $2

5. Adafruit Music Maker FeatherWing - MP3 OGG WAV MIDI Synth Player $19

6. Adafruit Feather 32u4 Basic Proto $19

7. 18650 Battery $4

8. TP4056--charger $1

9. Switch Rugged Metal On/Off Switch with Green LED Ring - 16mm Green On/Off $5

10. Icstation 1S 3.7V Lithium Ion Battery Voltage Tester Indicator 4 Sections Blue LED Display $2

11. Push Button -- generic $1

12. Adafruit Non-Latching Mini Relay FeatherWing $8
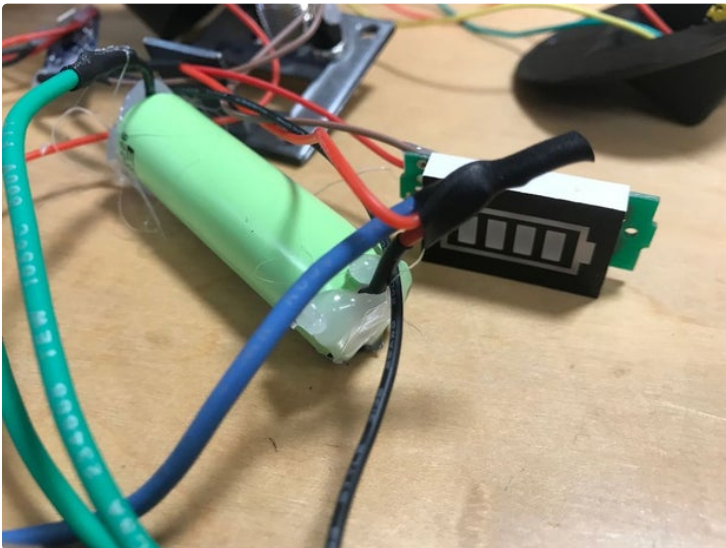
Step 2: 3D Print It

All designs were done in Fusion 360. The dimensions for the speaker cone were drawn from an analysis of horn design I found on the web:**http://audiojudgement.com/folded-horn-speaker-design/** The physics of it appeared complicated and the size of the horn is determined by what frequencies you wanted to illicit. I just ignored all that and took the horn profile which you can enlarge or reduce by how large an object your 3D printer can handle. I used a Creality CR10 loaded with PLA and it has held up ok with Alaska being fairly cold. For any other venue I would use PETG for added heat

resistance especially if you paint it black or the horn will begin to look like an old wizards hat ... which may be ok. The speaker cavity is designed for these really nice 2 inch speakers with amazingly good tone. There are 4 inch speakers from the same company that you might want to use but you'll have to modify the dimensions of the speaker housing for them. You will not need supports on any of the printed objects. The reason its split so oddly is to allow it to lie flat. I painted the horn with a "Chalk" style black paint for texture over the printed form. The rear mount with the electronics is painted with the Rock texturized paint. Do not paint the indent where the horns join as this will compromise the attachment.
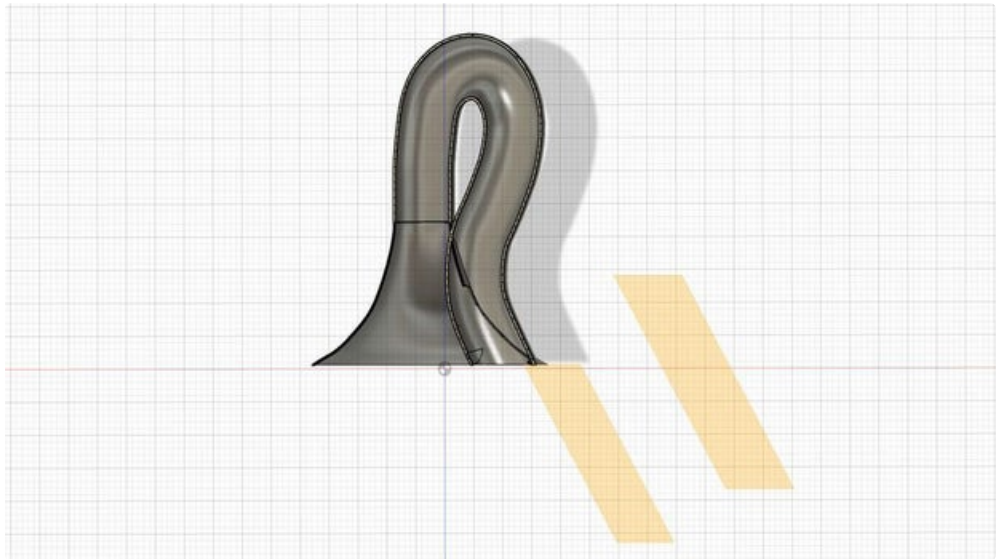
Step 3: Wire It

The unit works by supplying power from the 18650 battery to the PIR unit and the relay unit at all times. When the PIR detects movement it sends a timed high signal to the non-latching relay for a settable period for the song which powers up both the amp and the computer to initiate the random song selection from a SD card full of WAV files. The timer then shuts down the relay and the unit goes into standby until the next PIR call. Using the Feather approach made this fairly easy. I first attempted to use the stand alone sound board from Adafruit but unfortunately the random file selection was not truly random and it just repeated the same sequence over. The music maker feather shield allows you to use a replaceable SD card to if you want to change out to wind chime noises or snoring you can. It easily mounts to the top of the 32U base unit with header pins. You want to keep the relay unit separate to provide its own power to it which is always on. The power button provides power to the PIR. The battery level indicator is wired through a push button to check only when you need to. The amp is quite beefy and requires a big direct thick wire supply from the battery through the relay. Don't skimp on this wire size. The charger is the usual TP setup with the solar panels attaching to the input side of the unit. Use lots of hot glue to solidify the wiring before assembly.
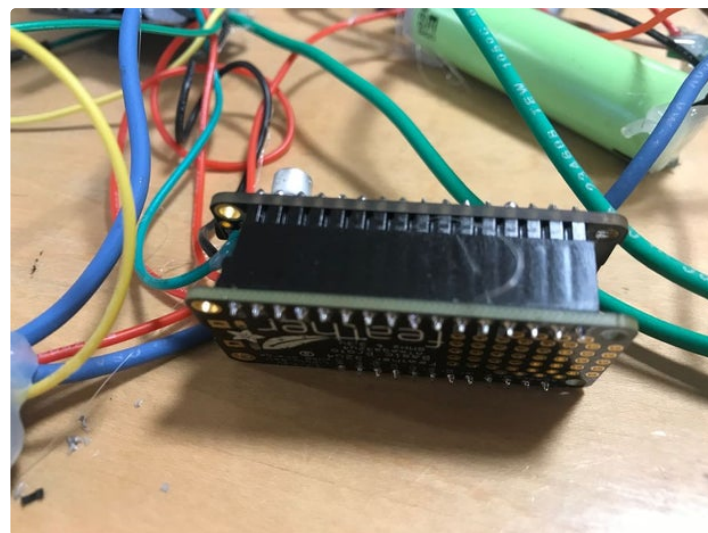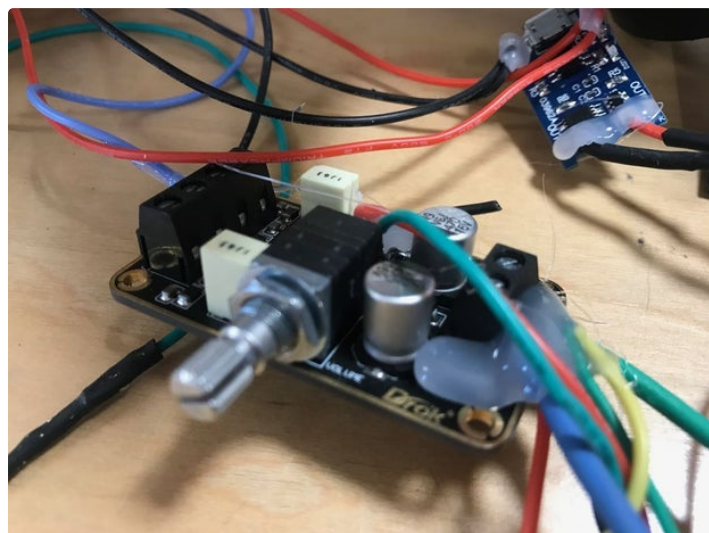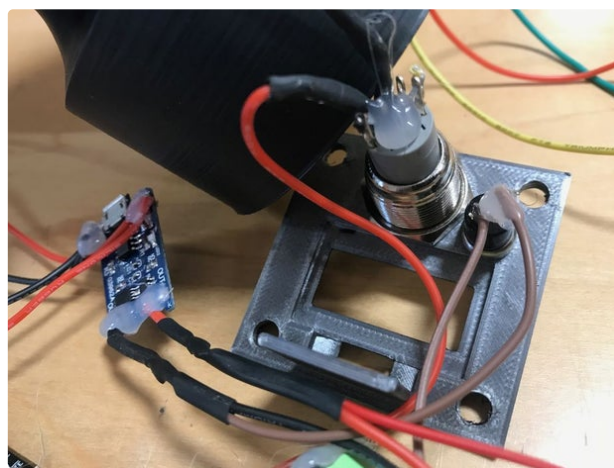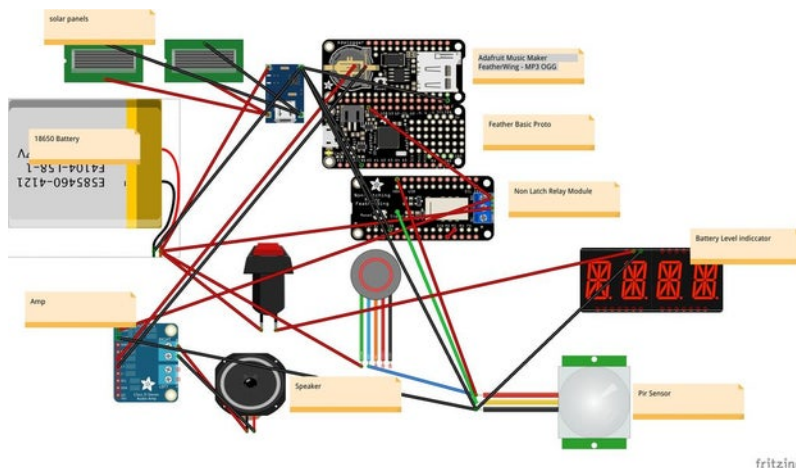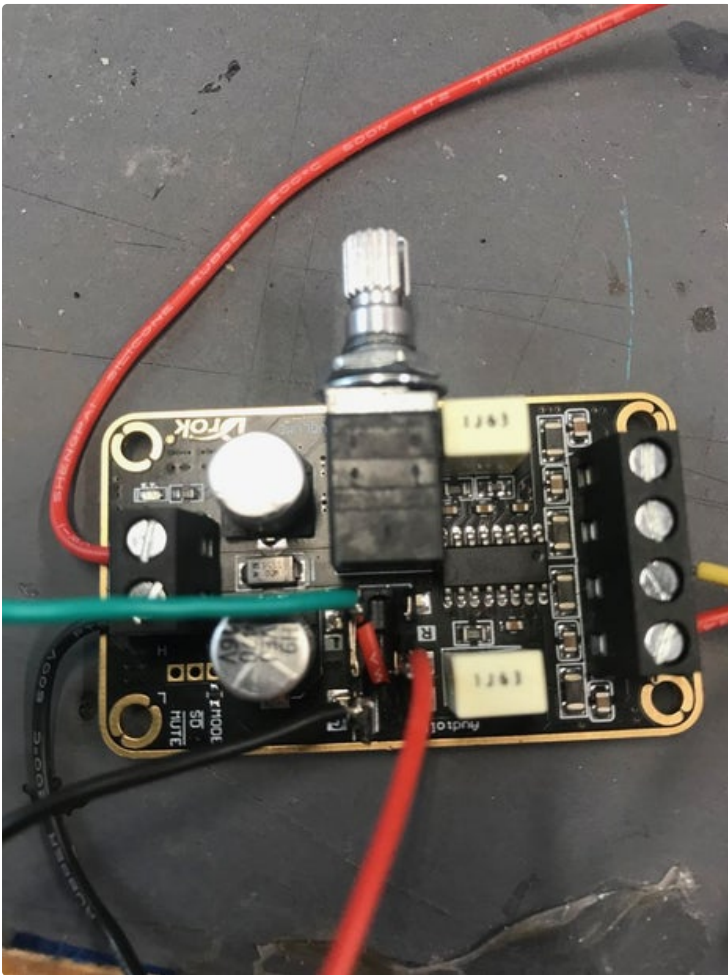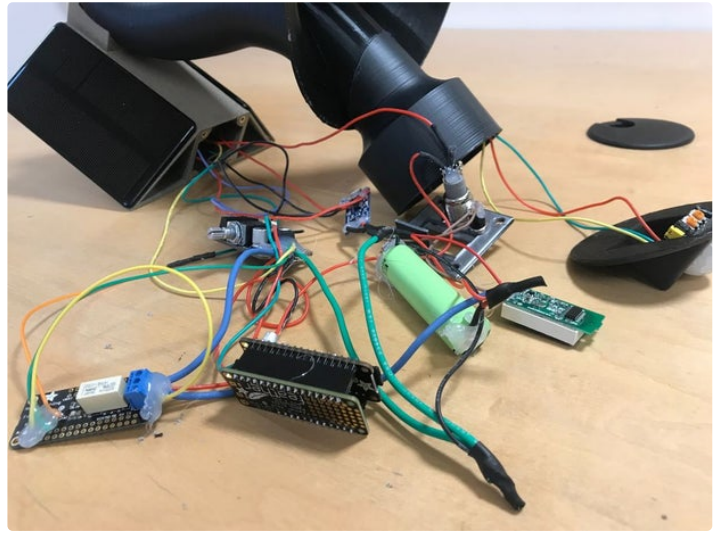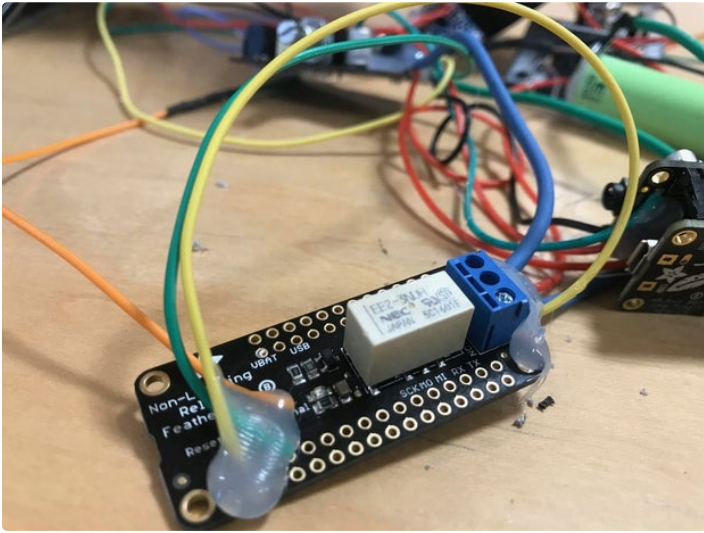
Step 4: Program It

Use the wonderful program Audacity to download sound from the repository at Cornell Lab and rerecord them in WAV format. I only use one channel in these recordings. This is a little tricky and involves changing your input and output settings on Audacity and there are many web descriptions depending on your computer at home. Unfortunately the lab does not allow direct download of WAV files but you can get excellent results by using Audacity to record them. Use this resource to make sure your files are ok for microcontrollers speed:

https://learn.adafruit.com/microcontroller-compatible-audio-file-conversion. Use this resource for background on using this board combination: **https://learn.adafruit.com/daily-cheer-automaton/overview**. The files above work well but you may want to use your own and in that case just continue using the same numbering system adding as many files as you want. You will have to change the maximum number of files listed in the software so it randomizes up to that number.

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Step 5: Build It

Glue the speaker into the speaker housing. There are four bolt holes but I found it just easier to glue it into position with E6000. The speaker wires must be made long enough so that they extend around the speaker opening and up to an exit hole in the mounting area of the horn and down into the control box. An additional three wires that connect the PIR must also extend this whole route. Glue the PIR sensor into its opening. Orient the PIR so that the controls for Sensitivity and Time are accessible. Connect the power, ground and data wires to the PIR. Look at the wiring diagram on line to make sure which is power, data and ground. Check where the horn and the mount mate -- it will be correctly orientated when the speaker hangs directly down. Drill a 1/4 inch hole in both the horn and the mount at about the same spot. Run the PIR wires and the speaker wires through the horn hole that you drilled. Using Gel-Superglue glue the speaker housing to the horn. Glue the solar panels to the mount using E6000 glue and run the wires

from these panels into the main housing on the mount. You will have to drill holes in the mount to navigate these wires. These panels produce over 6 volts so connect them in parallel to provide more capacity. Slowly fill the control box with the components starting with the battery followed by the Feather stack and relay and last the bulky amp. The ON/OFF is bolted to the control plate along with the battery checker, push button and finally the charging board is mounted to the plate that lines the micro USB port up to the charging port on the door. Four # 6 screws are used to secure the door after pre-drilling marked holes and heat mounting 4 knurled brass inserts. Adjust the time and the sensitivity potentiometers on the PIR after you have it running to see how long you want the songs to play (15 sec minimum) and how sensitive to heat signals. Finally use Gel Super Glue to seal the PIR plate to the speaker housing and attach the horn to the backplate.
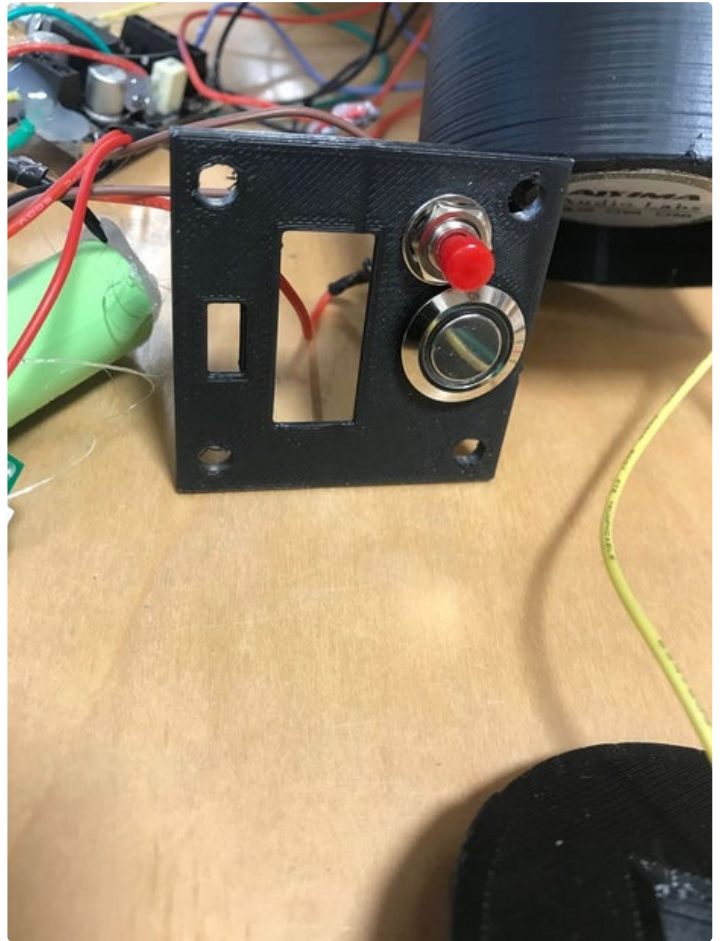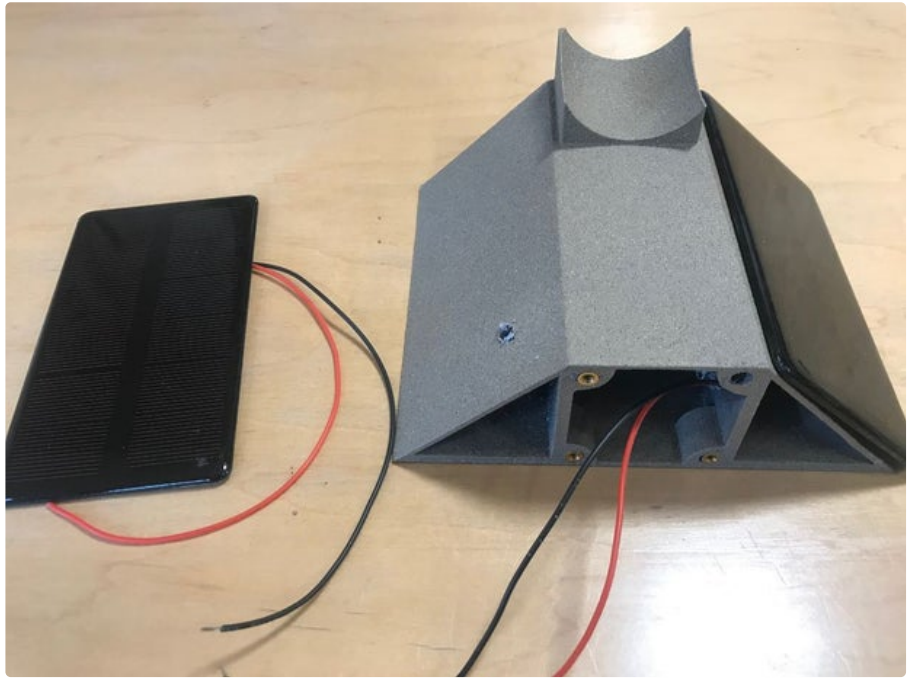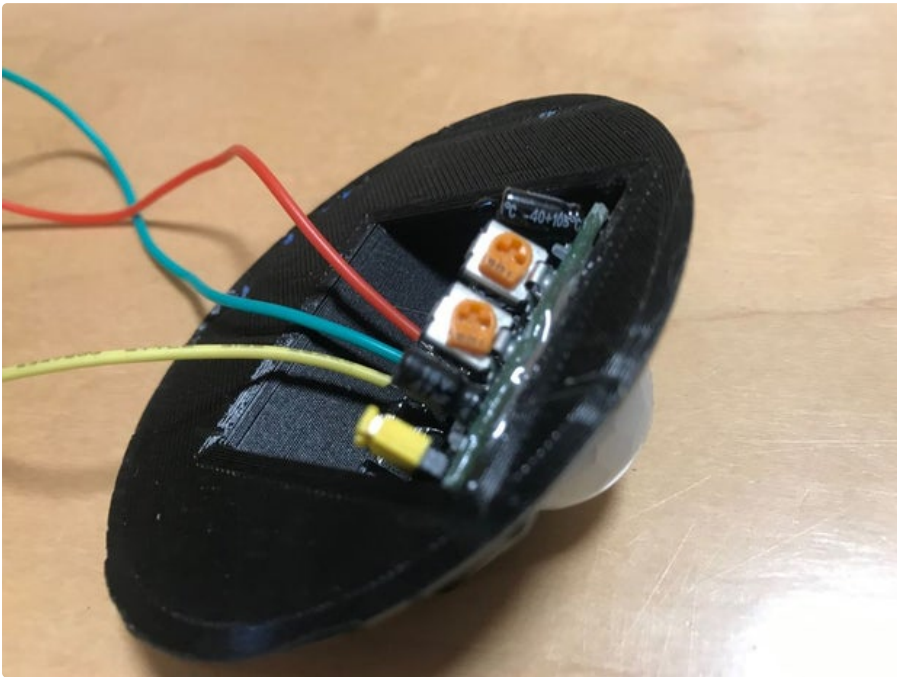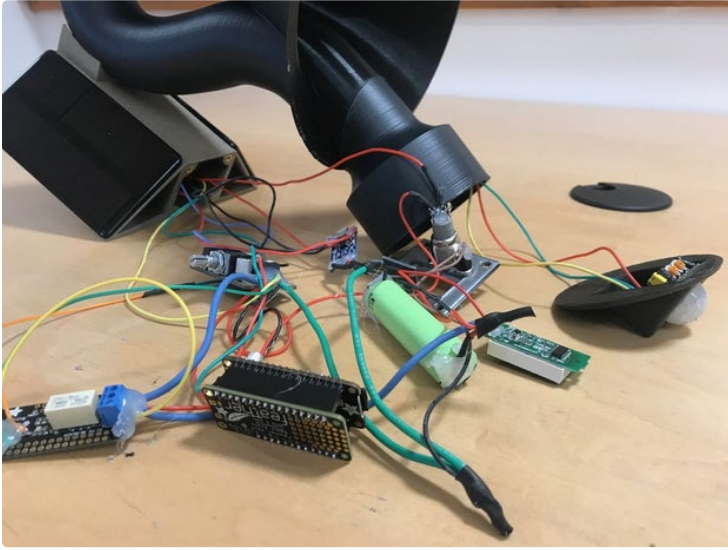
Step 6: Using It

The machine can either be solar charged or run through its micro USB charging port. Turning off the main switch still allows it to be charged through the solar panels and the micro USB. The battery power tester only comes on when you press the on/off button on the control panel to save energy. Mine has been running for a while now and easily keeps up with the power demands through solar only. The sound through the horn is remarkably loud and has very good tonal qualities. Im not sure of the physics of why it works but it does. When I grow bored with the bird noises I am planning on filling the card with a variety of "shushhhhhhhh" noises and donating it to a local library.

wow, that is a fascinating shape! looks like a klein bottle. i pulled up that article on audio judgment, but i didn't see the profile you copied from; did you just create that?

I love it! What a great idea. :D