

## Control glove build:

### Components:

- 4 buttons
- 1 cr2032 battery holder and battery
- 1 433Mhz transmitter

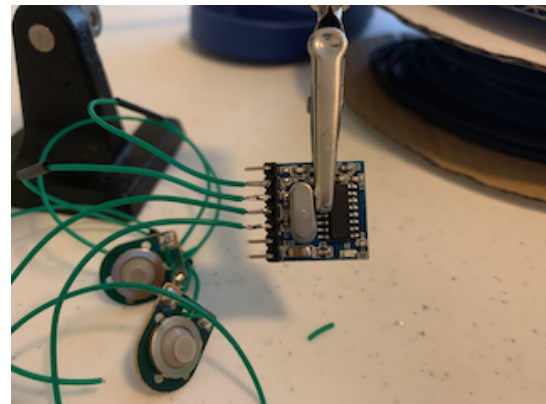


### Steps:

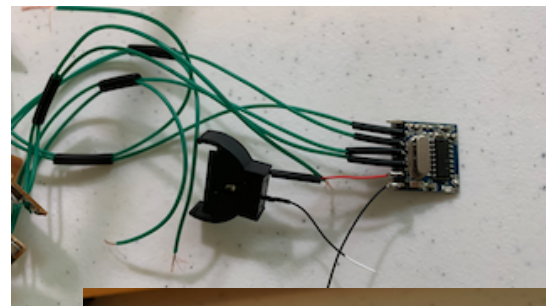
1. For each of the buttons. Cut the leads to about 5". Add a piece of shrink-wrap tubing over both leads (helps keep the wires for a single button organized). Add a smaller piece of shrink wrap on the lead that you'll solder, and strip the insulation off the end of that lead.



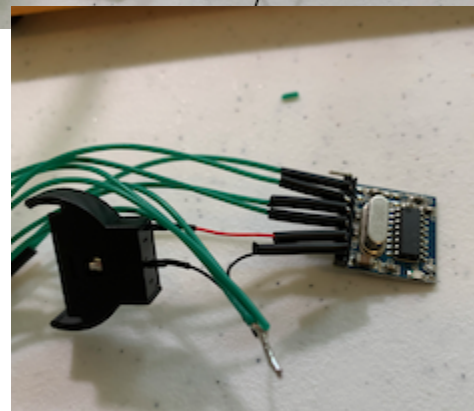
2. Solder one lead of each of the buttons to the pins labeled 1, 2, 3, and 4. (The other pins are '+' and '-' for power and "ant" for antenna (which we won't use).) Snug the smaller bits of heat shrink tubing up to the transmitter.



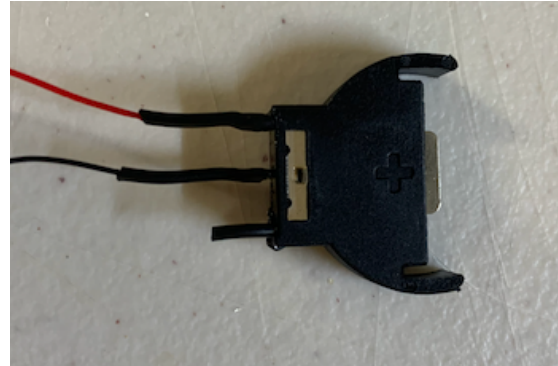
3. Strip the ends of the positive wire on the battery holder and a short (2") negative wire. Add heat shrink to both. Solder the positive wire to the '+' pin on the transmitter and the negative wire to '-' pin.



4. Strip and gather the remaining wires (these are all negative connections: the unconnected button leads, the unattached negative from the battery holder and from the transmitter) and solder together. Add heat shrink to protect the connection.



NOTE: Some available battery holders don't come with leads. For one common one, the "+" connectors are the two outside pins, with the "-" pin being the middle one. Connect a red lead to one of the outside pins and a black to the middle. Protect all pins with heatshrink as per the picture at right.

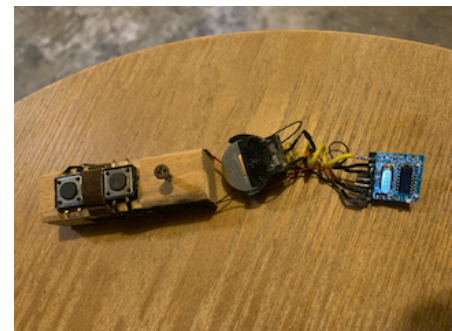


5. Add a cr2032 battery and test. You should see a light indicating activation on every button press. Use a heat gun to finalize the shrink wrap. Location of the buttons on the sound glove is determined by personal preference. Sew down the wires where necessary to keep from tangling. We tend to leave the transmitter and battery on the back of the hand, and you can add a fabric pouch there if desired. The battery should last a good long time (like your garage door opener), but replace it occasionally to avoid a failure during a troop.



As mentioned previously, for the Jawa you'll sew these buttons onto something like a compression glove, positioning the buttons as desired (the buttons have three small holes that can be used to tack the button in place). Generally you'll want to position the electronics on the back of the hand, sewing the wires into place in between to minimize tangles. You can cover the electronics with a fabric pouch if desired, just make sure you can replace the battery now and then. Also, we have found the pre-existing solder points on the buttons are prone to failure during use. One way you might reduce the failure rate is to put a drop of glue where the wire goes through the hole on the buttons. This will take some of the strain away from the copper.

Variations of this basic setup are also easy. At right there's a picture of a two-button version I made in order to control a sound system from a Tusken Raider Gaffi stick. This slides into the gaffi's PVC pipe body with the buttons exposed through a slot in the PVC. (The switches used here are different and are mounted on a piece of wood to keep them at the right height inside the pipe. To find appropriately small switches, google for "tactile button switch" and you should see options. Use momentary switches for this application.)



# Mask Build

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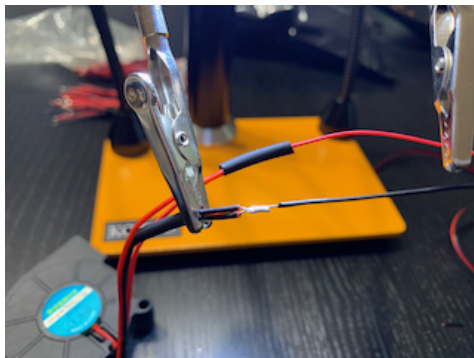
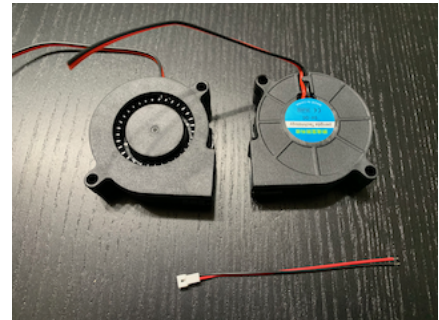
## Fan Assembly Build

Make 1 per jawa

Requires: 2 fans, male JST connector

Cut the fan leads to about 4" (no shorter!), strip leads on fans and connector, add heat shrink tubing, solder red to red and black to black and apply heat to the heat shrink to finalize the connection. Set aside the fan assembly until needed for physical mask assembly.

**WARNING:** During the Great Jawa Horde build, we found that one of our most common problems was the wires pulling off of the fans. There is a strain-relief (little plastic tab the wires run under), but they slip out easily and can then break or be pulled free from the solder points on the fan. To prevent this, consider a drop of glue or some gaffer's tape to try to keep the wires where they are and take some of the force if they get pulled.



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## Speaker Prep

Make 1 per jawa

Requires: speaker, 2 lead wires (we used the leftover wires after cutting the control glove button leads to length).

Solder leads to the speaker. This is somewhat easier to do if the wires aren't otherwise connected. Don't short the connectors to the speaker body. When done, set aside until the end of the electronics assembly. If doing a bulk build, return the speaker to the box it came in for protection.

Note that the front of the speaker has shiny metal that might be visible through the speaker grill we'll be covering it with..

Consider painting it with a flat black paint so you don't get reflections through the fabric.



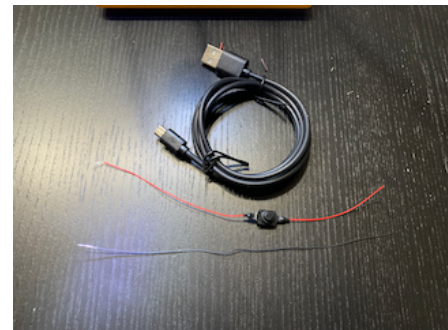
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## Power / switch assembly

Make 1 per jawa

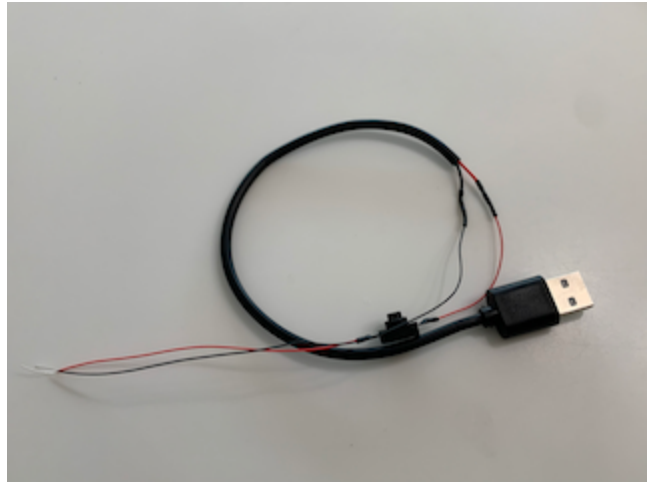
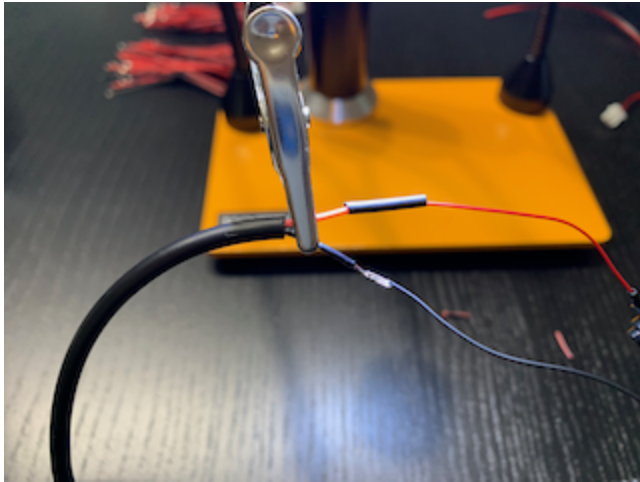
Requires: USB cable, on-off switch, 7" black lead

Cut USB cable about 10" from female end. Strip exterior insulation and identify the two power leads in your cable. In our cable they are red and black, with white and green carrying signal. Verify if necessary by connecting to a USB battery and using a volt-ohm meter to see where you get see 5V. You won't need the signal wires, so cut those short. Strip and solder the positive power wire to the red switch wire and the negative power wire to the 7" black lead. Protect the connections with heat shrink and set aside for final electronics assembly.



NOTE: The on-off switch that comes with our "parts kit" doesn't come with leads attached. You can solder the positive power wire directly to one side of the switch, and you'll want to add a red lead of at least 5 inches to the other side. Be sure to protect both sides with heat shrink.





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## LED eye assembly

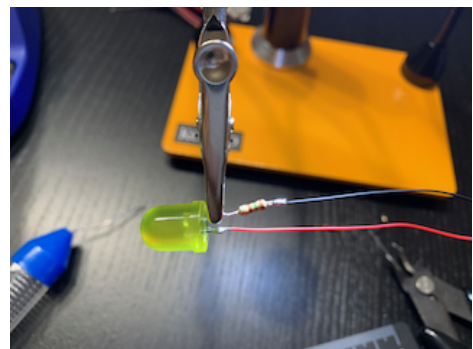
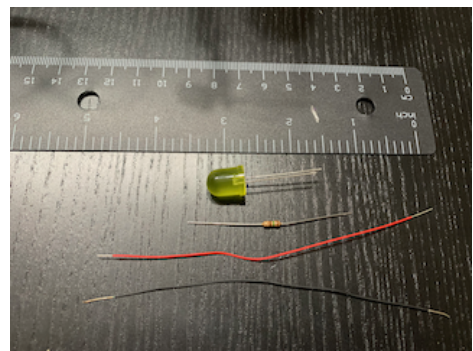
Make 2 per jaw

Requires: 1 LED, 1 resistor, 5" black and red leads

The negative pin on the LED is the shorter one. Clip that down to  $\frac{1}{4}$ " to  $\frac{1}{2}$ ", clip one end of a resistor the same length and solder them together.

Clip the other end of the resistor down to size and solder the black lead to it.

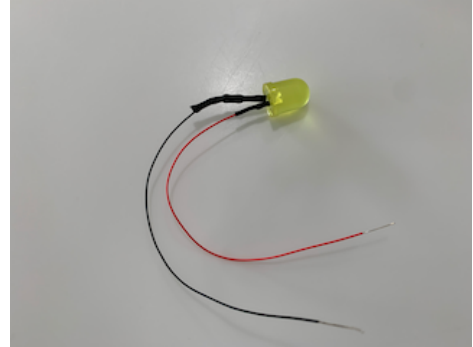
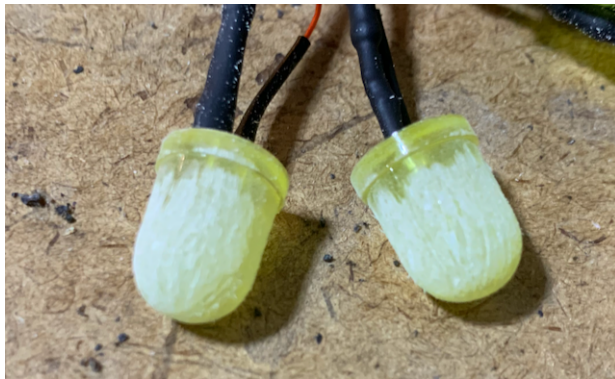
Then clip the 2nd (longer) pin on the LED down to size and solder on the red lead. This should give you an assembly like the picture at the right. (The easiest way to screw this up is to get the positive and negative pins



wrong. Double-check by touching each side to a CR2032 battery (like from the control assembly) to make sure it lights when red is on positive and black on negative. It doesn't really matter if the resistor is on the positive or negative side of this assembly, but being consistent makes life easier...)

Add heat shrink (you'll need a bigger size on the side with the resistor), and you should end up with an assembly like on the right.

Note: Many LEDs, even diffuse ones, "project" out the end rather than glowing evenly all around. This can give you a central "hot spot" in the jawa eye. You can address this by hitting the LED with sandpaper, or a sanding attachment on a dremel to rough it up. (Photo of roughed-up pair below.)



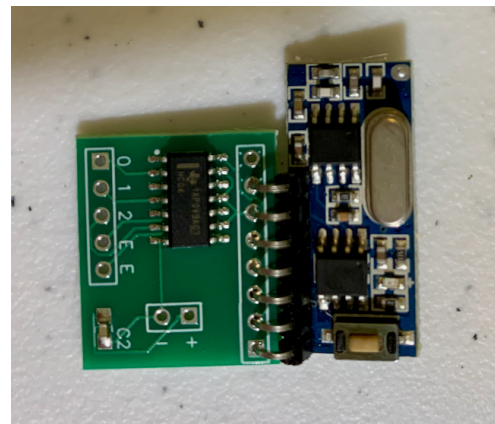
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## Final electronics assembly using the components above

Make 1 per jawa

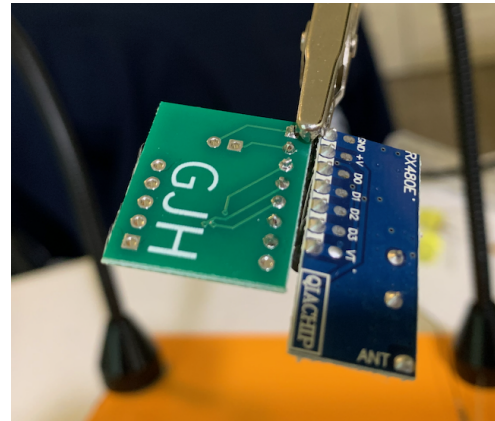
Requires: 2 LED assemblies, 1 fan assembly, 1 power assembly, 1 433Mhz receiver, 1 custom inverter board, 1 Adafruit Sound FX, 1 amplifier, 1 JST connector, hookup wire.

- Before you start soldering, make sure the board is loaded with the .WAV files in the

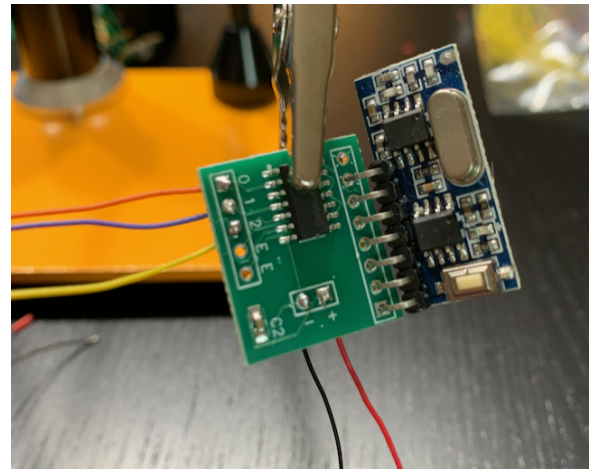


[JawaSounds.zip](#) file. You can also find this file in the [Files](#) tab. To do this, attach the Sound Board to a computer with a micro-usb cable. The computer should mount the Board like a USB drive. Overwrite the files you find there with the ones in the ZIP file. *If the sound board doesn't mount, try a different cable. Many microUSB cables designed for charging don't have signal wires.*

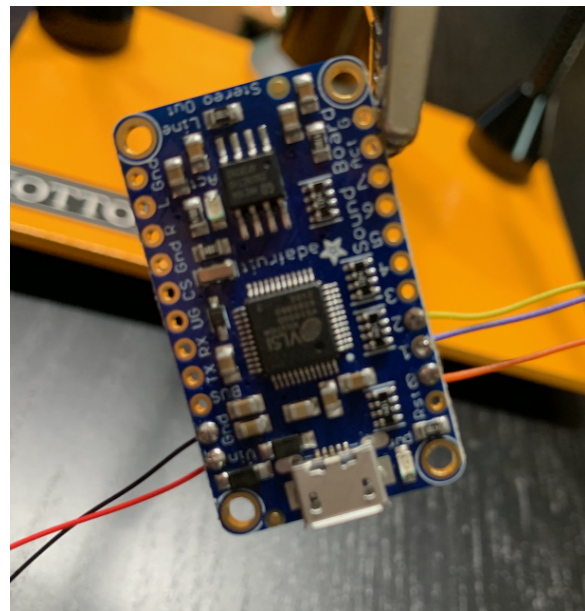
- Connect a 433Mhz receiver and a GJH custom inverter board as shown at right. There's an extra hole in the GJH board, so make sure the alignment is as shown. If you just insert the receiver pins into the inverter board, the boards will be at a 90 degree angle and will be awkward to place into the mask later, so it's best to insert the pins a little, then bend them using the board as leverage so that the two lay flat or close to flat. Then solder the six pins to secure.



- Next we want to connect 5 leads to the custom inverter board as shown at right. This includes power leads attached to the + and - connections (use red and black to avoid confusion, and 5 inch leads should be plenty). The other three wires are connected to the 0, 1 and 2 holes and need only run to the next board, so an inch or two of length should be plenty. We've used different colors but that isn't necessary if you can keep things straight. Leave the power leads unconnected for now.

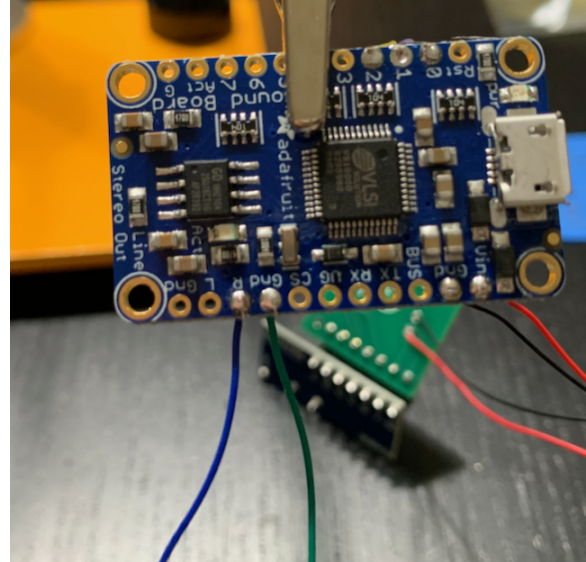


- Next we connect the three signal pins (0, 1 and 2) from the inverter board to the 0,1 and 2 trigger inputs on the Sound FX board as shown at right. Also add power leads to the Vin and Gnd pins on the FX board. Once again, 5 inch red and black leads are appropriate and should be left unconnected for now.

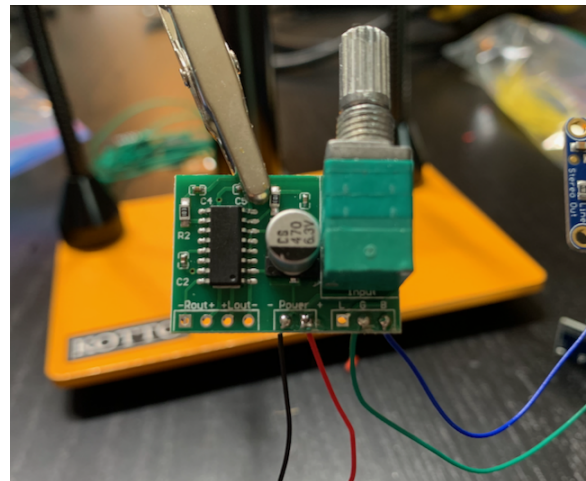




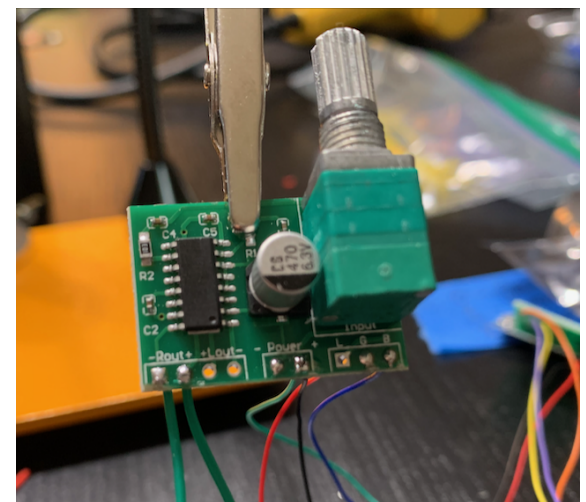
- Next, add two leads to the right channel audio output pins on the sound board, labeled R and Gnd (the one right next to the R, probably it doesn't matter which Gnd, but no reason to push it). Their positions are shown at right. We just have a single speaker, so we won't be using the left channel. Again, the color of the leads doesn't matter as long as you can keep them straight. We're just running them to the next board, so an inch or two long is fine.



- Next we connect the final board, the amplifier. Like the previous board it will need roughly 5" red and black power leads attached to the + and - holes. Then attach the audio signal leads from the FX board to the audio input points on the amplifier. Make sure to get the Gnd on the FX attached to the middle 'G' input on the amp. The 'R' pin on the FX attaches to the right hand pin on the amp. (It should be labeled 'R', but on ours it looks more like a 'B').

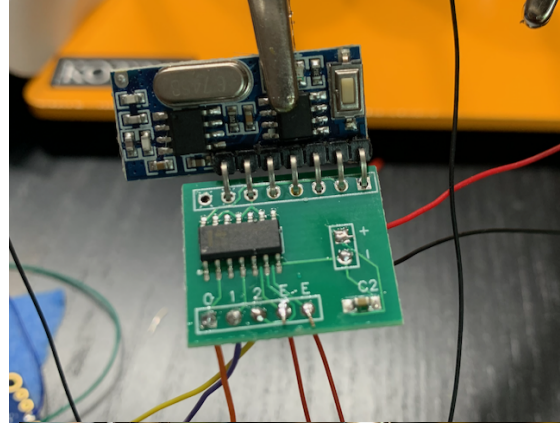


- We're done adding boards, but we have a few more connections to make. First, connect the speaker leads to the amplifiers output. We're using the right channel, so make sure to use the Rout pins. Polarity is not particularly important for the speaker connection.

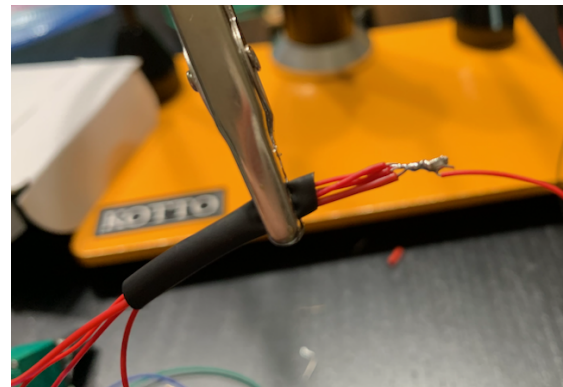




- Now, connect the positive (red) leads of the eyes to the 'E' holes on the custom inverter board. Leave the black leads unconnected until the next step.



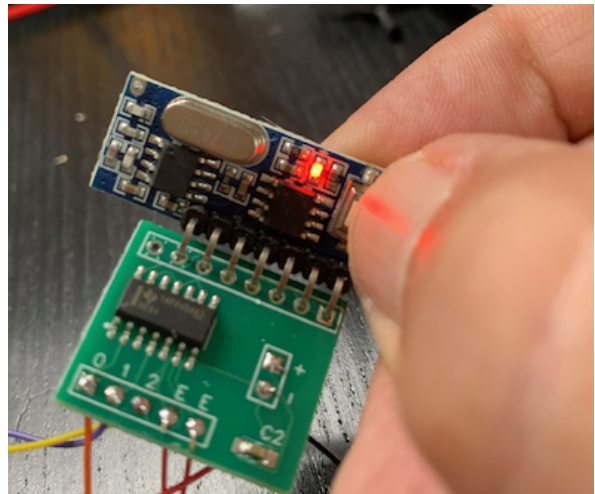
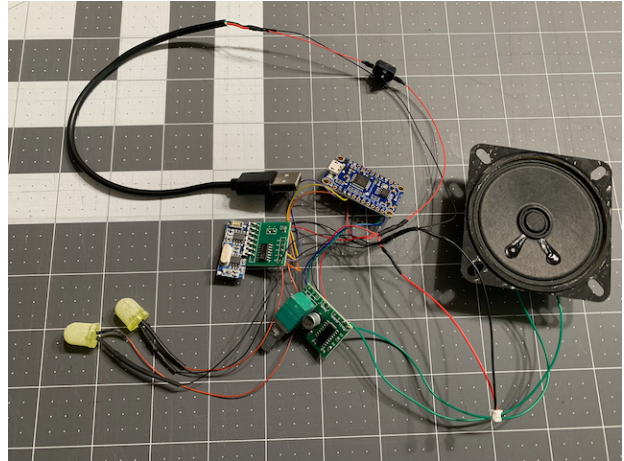
- Last, we're going to finalize the electronics assembly. This requires the assembly we're created in the previous steps, plus a previously-created power assembly (USB cable and switch) AND a female JST connector (this will power the fans). First, identify all the unconnected black leads. You should have 7 in total: one from each of the 3 boards, one from each of the two eye LEDs, one from the female JST connector and one from the power assembly. Make sure all have their insulation stripped to an appropriate length, exclude the power black, gather the remaining six together, tuck them into some heat shrink and twist the ends to keep them together. Then solder them together with the black lead from the power assembly facing them as shown above. Pull up the heat shrink to cover the connection and shrink to secure. Do the same thing with the unconnected red leads, except that you should have only 5: one from each of the 3 boards, one from the female JST connector and one from the power assembly. Solder and secure with heat shrink.



## Testing the Electronics Assembly

The final electronics assembly should look like the picture at the right. But before you go further, this is the time to test the system. In order to do that, you'll need a USB battery pack and one of the control glove assemblies built above.

- First, plug the USB cable on the electronics assembly into the battery for power. You should see the eye LEDs come on and a blink of life from the FX board and the 433Mhz receiver. If you do not, disconnect the power and proceed directly to the "Troubleshooting" section below.
- Next, briefly press the white "pairing" button on the receiver ONCE. You should see the Red LED next to it come on while you press it, go off, and then blink on again indicating that it's ready for pairing. Once that's happened, press any button on the remote control you want to pair with this assembly. Again, you should see the Red LED blink when you press the button on the remote as it pairs.
- At this point, your remote should be paired with this electronics assembly and you should hear noises and see the eyes blink when you push the buttons on the remote. If you do not, go to the "Troubleshooting" section.



## Mask preparation

Requires: softball mask, eye mount board, “crown” board, eye covers, battery bag, zip ties and gaffer’s tape.

- Using a dremel cutoff wheel, make cuts as shown at the right. (This is based on the GameFace mask depicted and should be modified if you’re using a different mask.) Basically we’re removing the central part of the face protector, including the middle three of the 5 verticals. Cut those verticals as flush with the bottom of the mask as possible. (Temporarily remove the chin rest to avoid damaging it.) The horizontal pieces should be cut at an angle so that the eye/speaker mounting plate can lay flat across the front of the mask.



The image at right is how it should look after cuts looking down from the top of the mask. The side-to-side cut line is about 3” out from the deepest point of the eye area, but mostly just make sure you don’t take out any of the vertical that supports those pieces.



- You’re also going to need some zip-tie holes for mounting things. Note that these locations are approximate, so if you’re just doing one build, you might drill them when you need them.
  - First, you’ll need 4 holes in the chin area, roughly  $\frac{1}{4}$ ” down from the edge, with one roughly below each of the 4 outside verticals (not the center one). These are for attaching the speaker (middle holes) and the eye mount plate (outside holes)





- Next on the right side, drill one hole in vertical strut halfway between the two horizontal pieces. This is for the eye mount plate. Then two more holes roughly where shown for mounting the fan.



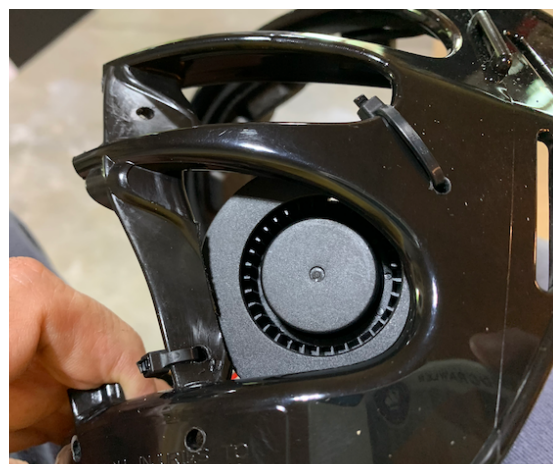
- On the left side, you need a hole like the one above in the vertical strut between the two horizontal pieces for the eye mount plate. Then two more holes, one at the bottom of the horizontal strut and one near the cheek for mounting the fan. (You may want to wait to use the fan as a template before drilling these so they are positioned well.)



- Finally, drill one hole about ¼" up in the center of the top of the mask. This will help mount the "crown" that extends the mask upward so the forehead is hidden.



- The next step is to mount the fans on the mask with zip ties (4 required). It doesn't really matter which side you start with, but remember that we want the fans to pull air from the outside, and to blow towards the back. (Your mileage may vary here, but generally we've found that blowing towards your neck provides the most comfort.) The next few pictures are of the left and right hand side fans mounted in the mask, both outside and inside views.



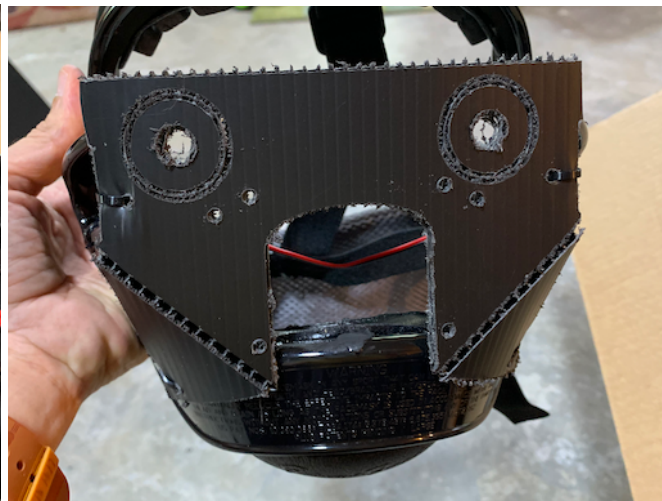
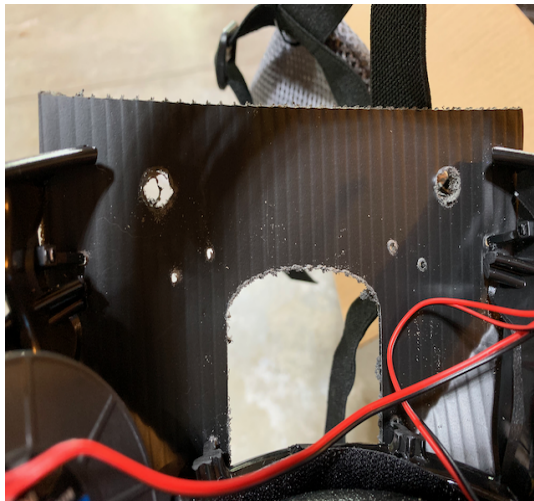




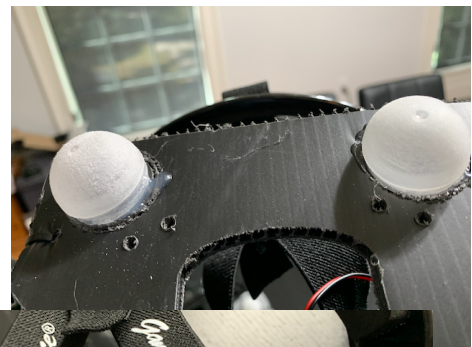
Trim the ends of the zip ties when done. Note that the width of the vertical strut on the GameFace mask makes fan mounting a little awkward. We've trimmed it down a little with the dremel. On the left side the fan is a bit behind and on the right it's next to the vertical. Either works. As long as nothing is touching the rotating part of the fan and the opening is largely free, everything should work fine. A similar arrangement should work with other softball masks if you can't source this exact model.



- The next step is to attach the eye mount panel. This also requires 4 zip ties attached through holes between the horizontal struts on either side of the mask, and through the outer holes on the chin area. Generally it's wise not to tighten any zip tie completely until the others are in place to give a little wiggle room. When attached, the eye mount panel should rise  $\frac{1}{2}$ " or so above the top horizontal strut on the mask. The pictures below show the attached panel from each side as well as from the front and back.



- Install the eye covers (vending machine capsules, sanded for opacity). The 1" circular areas cut halfway through the corrugated plastic on the "face" plate provide good purchase for the hot glue.
- Use zip ties to attach the battery bag to the head strap on the back





of the mask. The USB cable will come from the wearer's left, so orient the opening of the bag in that direction. We've found it easiest to run the zip ties through the woven fabric of the bags we use, then just loop it around the wide mask strap. Doing this outside the "pony tail" triangle will keep the bag from slipping side-to-side.

- Install the corrugated plastic "crown" by zip tying it to the top and sides of the mask. First, attach the middle. There are two holes in the middle of the crown and we drilled one in the middle of the mask,  $\frac{1}{4}$ " above the eye opening. The zip tie should loop so that it goes in through the top crown hole, through the drilled hole in the mask, out through the mask eye opening and then back through the other hole in the crown, as shown at right.



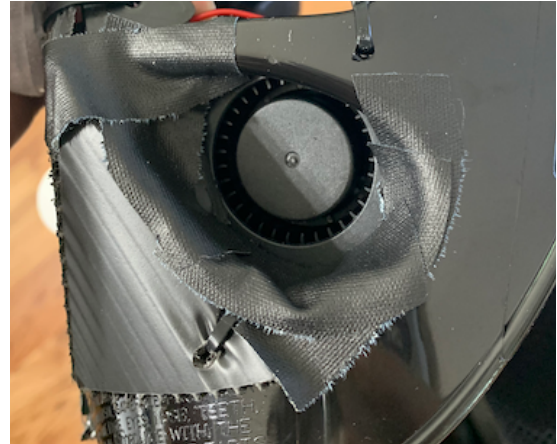
Pull the zip tie tight and trim the end.



Then attach the crown at the right and left sides. In each case the zip tie goes through the side of the crown at a single hole, and attaches to the mask by going through the eye opening and the strap opening as shown to the right.

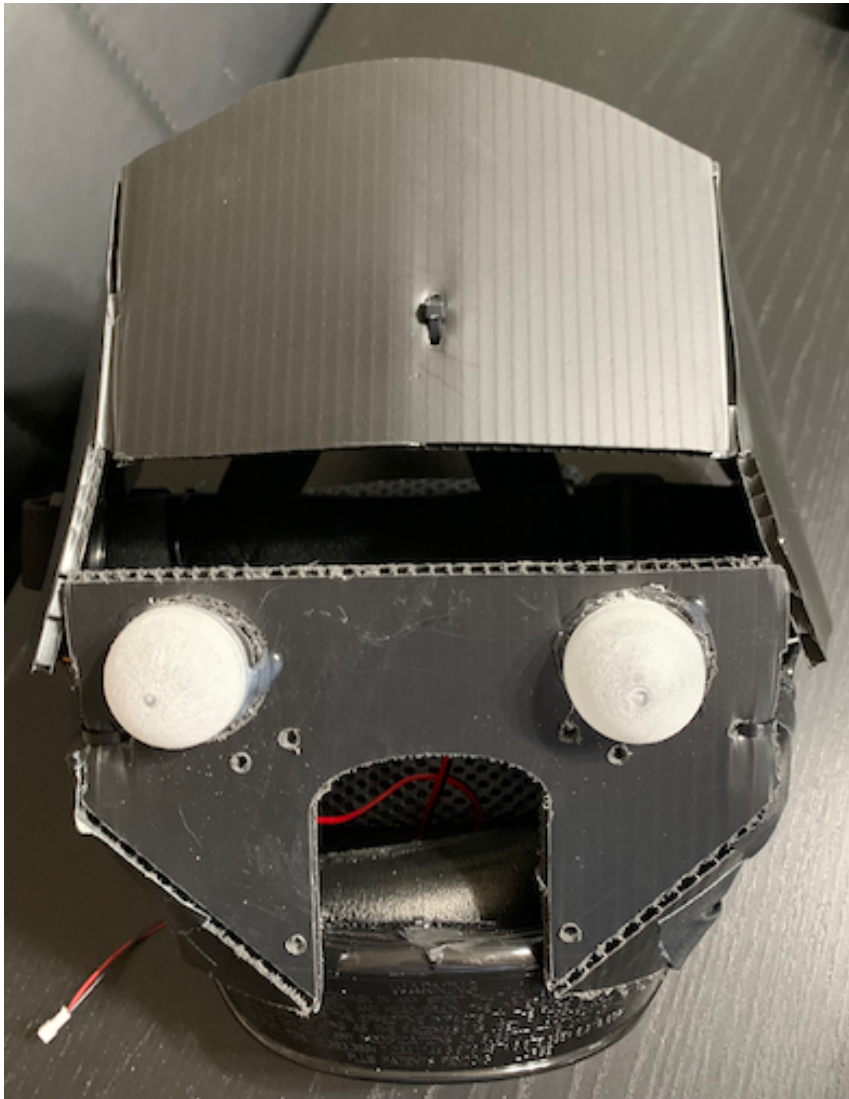


This is also a good time to “seal” the area around the fans with tape. This isn’t critical *per se*, but it does help to make sure that the fans pull air through the mask’s fabric cover instead of just blowing air around inside the mask. No need for perfection, just try to seal air gaps and don’t stop the fan from rotating. Pics below.



The result should be a physical mask assembly ready for electronics installation. This is a good time to check your visibility and adjust the opening if desired. The bigger the opening, the more visibility you have, but it also lets more light reach your face and people may be able to see your eyes. You can reduce the opening with gaffers tape, or trim away the corrugated plastic to expand it.

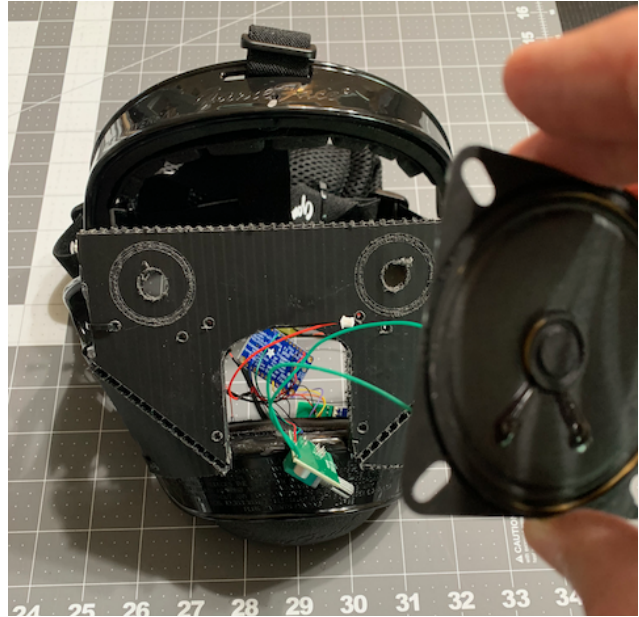




## Installing the electronics

Requires: mask assembly, electronics assembly, zip ties, mounting tape, gaffers tape

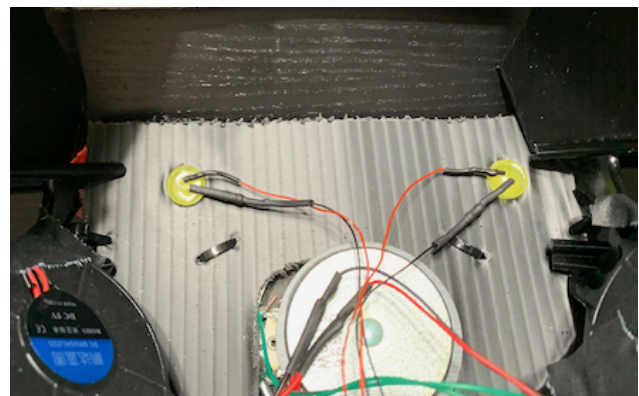
- From the front of the mask, insert the electronics assembly through the speaker mounting hole as shown at the right.



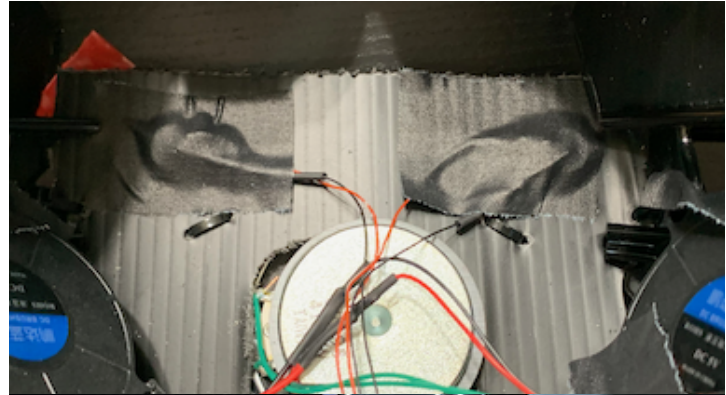
- Use zip ties to secure the speaker to the “face” plate and trim ends.



- On the backside of the face plate, insert the LEDs into their holes and (carefully) bend the leads flat. Also, connect the JST power connectors from the electronics assembly to the fans.



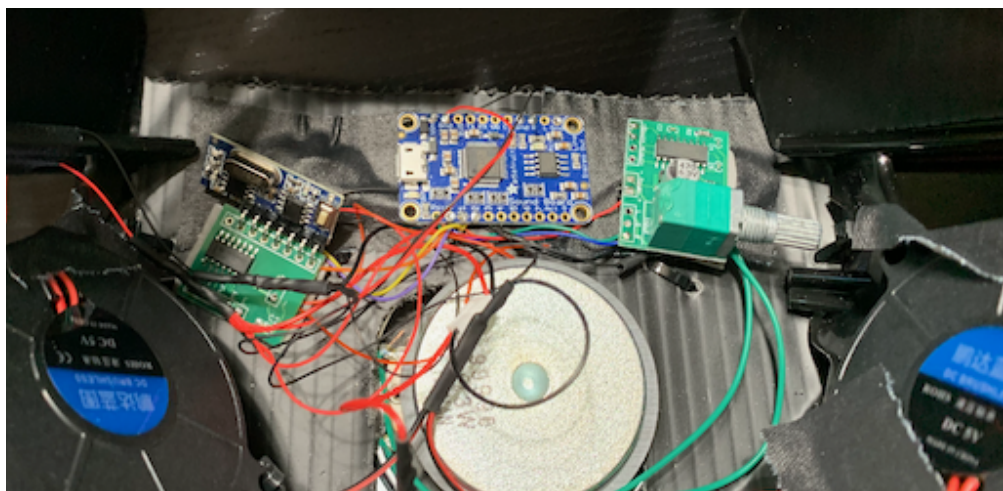
- Cover the LEDs and leads with tape. (This protects the leads, and keeps the glow from the LEDs from lighting your face.)



- Secure the switch near the left cheek. You can use a small piece of mounting tape to keep the switch in place, as well as tape to secure and protect the wires. Feed the female USB cable up through the loop of the strap.



- Using mounting tape, secure the amplifier board, sound board and remote control assembly to the face plate. We've found the arrangement below works well.





- At this point, you may want to connect a battery and retest the system to make sure you haven't dislodged a wire. If all works well, secure the wires with tape. Note that there are lights on the sound board and remote receiver that you may wish to cover to avoid their glow lighting your face. You may wish to leave the USB jack on the soundboard accessible in order to change your sounds. Note that we've removed the chin rest on the mask here for easier access. Don't forget to put it back. We've also added some tape over the fan leads because those are common failure points.





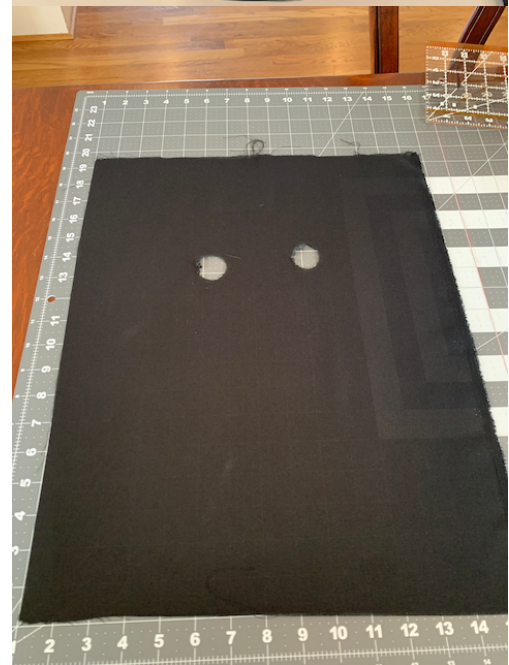
## Mask finalization

Requires: mask assembly, speaker grille, gaffers tape, fabric cover, hot glue, elastic, velcro

- First, install a speaker grill over the speaker to protect it from damage. If the grille looks shiny, you may want to hit it with some flat black paint before installation. A few pieces of tape should secure this well enough.



- You should have some semi-see-through fabric to cover the mask and obscure the eye openings. Cut to an appropriate size and make eye holes in appropriate places. The Great Jawa Horde does this with a jig that involves a couple short pieces of 1" copper pipe and a propane torch (fire leaves edges that don't fray), but that's not practical/necessary on a small scale.



- Secure the fabric to the mask. We usually do this by putting some hot glue down around the eyes and then gently pushing the fabric into it. Then tape the fabric around the crown and sides of the mask. You may have to trim the fabric a bit, and the fabric might not reach all the way to the back of the mask, but it's the front that's most important. Your hood will prevent the rest from being visible.



- Finally, sew some elastic with tabs of velcro on the ends to the bottom of the mask. We find that this arrangement helps to secure the fabric around the neck and keep it from escaping the hood and robes. Depending upon fit, you may need to adjust the length of the dangling fabric. You may prefer another solution, like a balaclava, for hiding the neck, but we've been happy with this one.



## Troubleshooting

New system: If you get to the end of the build and don't have a working system, hopefully a review of the build steps will resolve the problem, but from our experience debugging systems, here are a few things you should look for:

- If you have no lights or fans, you've obviously got a power problem, maybe a broken or loose wire around the switch or after, but you may also have a short circuit somewhere. The USB battery is smart enough to shut itself down in this situation, so it may not be obvious. Check for solder bridges between the + and - pins on any of the boards or on the fans (particularly if you've had to repair the leads on a fan).
- If any one item (fan, eye LED, etc isn't on), obviously check the connections to that device.
- If everything seems to be normal but you're not getting sounds, check to see if your eyes blink on the appropriate button press. If they do, the problem is in the actual sound system. If not, you need to focus on the receiver and the custom board.
- The adafruit board has a light that comes on when it's playing a sound file. If you don't see it then the problem is with or before that board.
- It's relatively easy to accidentally wire to the wrong channel on the sound board output, amplifier input, or speaker output, or to twist the volume on the amplifier too low or even off, all of which will result in no sound being heard.
- Lastly, there is one circumstance that may seem quite weird if you encounter it, but which has a simple solution. You may find that when you press a button on the remote, you get sounds that repeat continuously, stopping only when you turn off your sound system. This *probably* means that your receiver got switched to a different mode, possibly by the pairing button being hit more than once when it was in pairing mode. The solution to this is to reset the receiver and re-pair it with your remote. To do this, turn the system off and back on again, and push the pairing button 8 times to clear its memory. Power off and on again, press the button once and then touch any button on your remote to re-pair.

Old system: Suppose you're having problems with a system that worked before. Presumably you'd realize it if your USB battery had no charge and therefore you didn't have fans or lights when you hit the power switch. But suppose you have lights and fans, but nothing happens when you press the buttons on the control glove? Check to make sure you have a green light lit on the control transmitter when you press a button. If not, replace the CR2032 battery on the glove. Normally these last a long time, but maybe the glove got crushed by something in your costume bag, pressing a button continuously and discharging the battery. Carry spares just in case.

If the transmitter shows a light, the receiver should also show a light when it gets the signal. If it doesn't you've got a problem. You don't have two jawas in the house do you? Maybe you grabbed the wrong control glove? Check and see. If not, it's possible that the receiver has become unpaired with the transmitter. Press the pairing button on the receiver ONCE (hopefully it's not been covered with tape) and then press a button on the control glove. You should see a



light blink (3 times) on the receiver indicating pairing has been re-established. Subsequent presses should get you sounds. Beware, pressing the pairing button twice or three times puts the receiver in modes other than the “momentary” mode that we want here. If you screw that up, press the pairing button eight (yes, 8) times to clear its memory completely. This will cause its LED to blink 7 times in confirmation and then you can start the pairing process again.

If the receiver shows a light, but you’re not getting a sound, check the volume knob on the amplifier. It’s possible to turn that all the way off, which isn’t conducive to it working. If you still don’t get a sound with the amp volume twisted all the way in either direction, you should double-check the filesystem on the FX board and make sure it hasn’t been corrupted. But if it looks good, you’re probably going to be pulling all your tape off to check connections and run through the “New system” troubleshooting above.