storment | Don't weather your storm alone.

NWMEDIA C203 / ME C205 Critical Making
Provocation 03: Cosmetic Computing
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All resources, Illustrator files, and code can be found at: github.com/mimilei/storment

HELMET
Materials Required:

- 15" diameter (IKEA) lamp shade
- Blue painter's tape
- 2, 1/16"x18"x27" PETG sheets
- 1 small butt hinge
- Hardware
- ⅛" plywood
- ⅛" acrylic sheet
- ¼" acrylic sheet
- 4, ¼" diameter disc magnets
- Insulated wire
- Solder
- Clear vinyl fabric
- Clear packing tape
- Cotton batting (pillow or stuffed animal stuffing)
- Carabiner

Tools Required:

- Marker
- Hacksaw
- Vacuum former
- Clamps
- Electric drill
- Precision knife
- Scissors
- Screw driver
- Soldering iron
- Hot glue gun
- Laser cutter
- Strip heater (acrylic bender)

Instructions:

1. Acquire a large, at least 14" in diameter, spherical or semispherical object, preferably made of metal, rigid plastic, or wood. Also avoid textured objects, as all details of the texture will show in

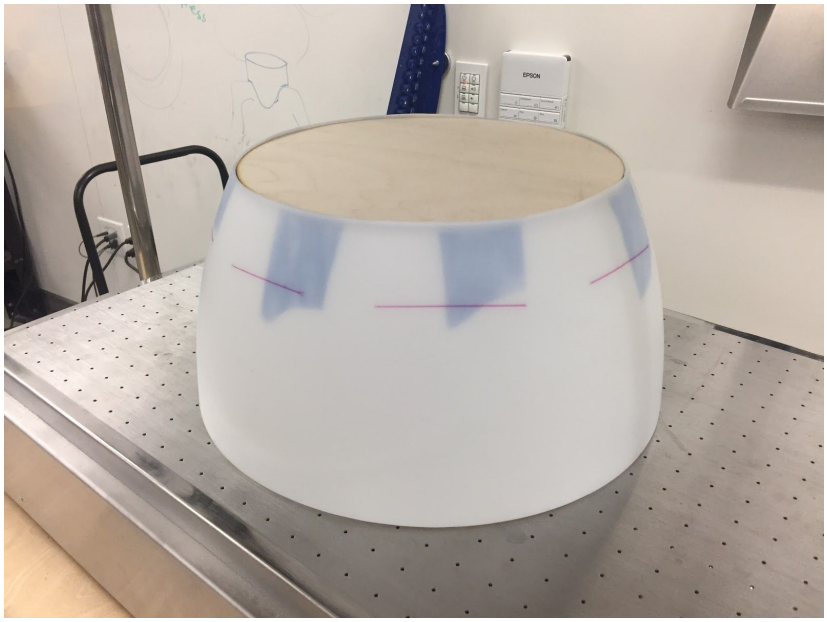
your final product. This object will serve as the mold for the two halves of our helmet. We initially looked at large semispherical salad bowls, but their diameter was not large enough, so we chose a polycarbonate lampshade with partial spherical curves. It's largest diameter was 15".

2. Halving the diameter, we measured out multiple strips of 7.5" long painter's tape, and stuck them onto the lampshade starting from it's base. We connected these strips of tape to get a parallel path to the base along which we could cut.

3. Due to the lampshade's awkward shape, we stabilized it with our hand strength while another cut along the taped path with a hacksaw.
4. Measuring the new diameter of our cut, we laser cut a plywood disk of equivalent diameter which would seal our object and form the flat front and back of our helmet. The plywood disk was carefully aligned and taped into place on the underside of the lampshade to prevent tape outlines

from showing through the vacuumformed piece. The plywood disk was supported underneath by the leftover lampshade or any other object of similar height so it could withstand the forces of the vacuumformer. This would serve as the mold for the front half of the helmet.

5. Acquire at least 2 clear thermoplastic sheets for vacuumforming, more in case mistakes are made.

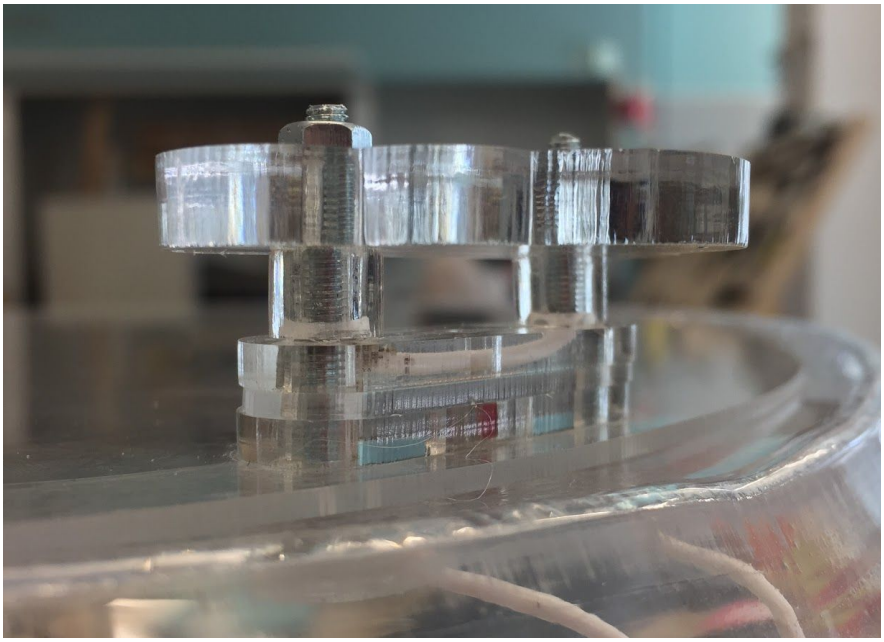


PETG, acrylic, or polycarbonate will all work, but we chose PETG because it is the easiest to work with.

6. Set up your vacuumformer with your thermoplastic sheet and center your mold on the bed so that it surrounding by vacuum holes on all sides. Make sure your vacuum is strong.
7. Turn on the vacuumformer's heating elements and wait until the thermoplastic droops to the approximate height of our mold, around 7.5" in this case. For our vacuumformer, this took about 5 minutes. At this point, coordinate with a partner if necessary, and quickly drop the heated material over the mold. Because our mold is quite large, helpers on the sides may have to press down on the edges of the vacuumformer bed to improve the seal. Turn off the vacuum motor when the plastic forms well to the edges of your mold. If left on for too long, the vacuum could deform the mold.
8. Wait for the plastic to cool another 5 minutes before removing the mold from the part. Because there are no undercuts and because of its dome geometry, the mold should pop out easily.

9. To form the back half of the helmet, remove the plywood disk and once again cut off about two inches off the top of the mold so that is is slightly shorter than the front. Measure again the new diameter and laser cut another plywood disk to tape onto the top of the newly cut lampshade. Repeat the vacuum forming process for the second half. If done correctly, only two sheets of plastic material should be needed. Roughly cut out both helmet halves from their original sheets leaving over an inch of flange. The flange with be trimmed down later. We found scissors to be the easiest tool for cutting the 1/16” thick thermoplastic sheet.
10. To form the hatch on the front half of the helmet, trace a circle about 0.5” offset from inside of the flat top of the dome and cut using a precision knife. Using a butt hinge and preferably silver hardware, attach the hatch back onto the helmet at the base so that when opened, it falls downwards. You can choose which sections of your vacuum formed halves form the base. We recommend choosing the least sharply formed edge as your base since it will eventually be cut to create a hole for the wearer’s head to enter.

11. Lasercut a clear acrylic circle (0.5” offset outwards from the opening) as the door using the Front door.ai file. There are attachment holes on the door for the hinge and handle (lasercut from acrylic in any shape you like — we chose a cloud). Magnets are attached to both the helmet and door to allow the hatch to be tightly sealed when closed. The handle is converted into a switch by connecting the two bolts on the door with a wire, with two more wires on the helmet. When the hatch is closed, the circuit is complete which triggers the electronics.

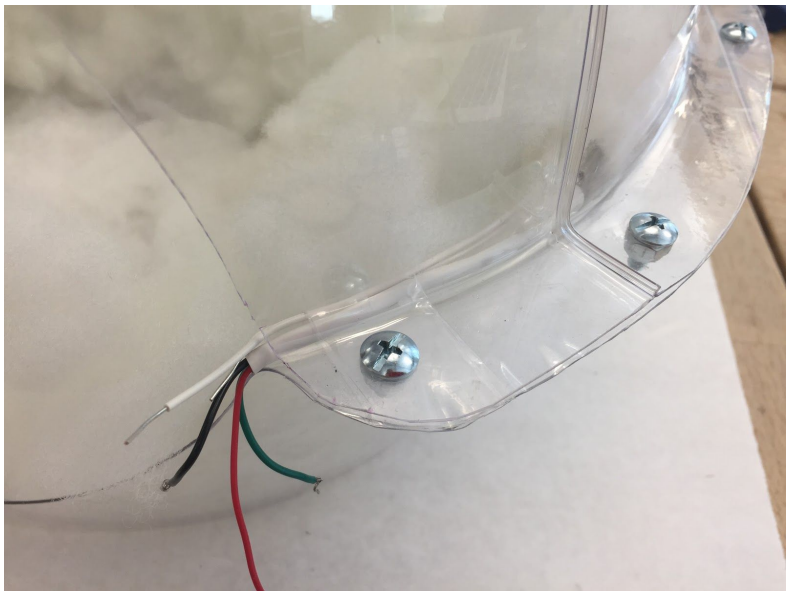


12. Vinyl fabric is sandwiched between rigid plastic parts to help seal the fog inside the helmet. Its compliance helps fill any spaces and gaps between the helmet halves and hatch when it is clamped together. Vinyl is therefore lined along the perimeter between the front half of the helmet and the hatch, as well as along the perimeter between the two halves of the helmet.
13. Measure out a ring of vinyl fabric to go over the perimeter of the hatch and cut out with scissors. Use clear glue, acrylic glue in our case, to adhere the vinyl to the helmet, not the hatch lid. Measure out another ring of vinyl fabric with at least 15” ID to go between the flanges of the two helmet halves. To avoid glue marks, this vinyl will be clamped using hardware. For now, place the vinyl sandwiched between the two helmet halves.
14. Temporarily clamp the two helmet halves together to measure out the hole for the wearer’s head. We used binder clips to achieve this. From a top view, the head is longer from back to front (nose) than it is from side to side (ear to ear). We found that at least 9.5” distance between the back and front of the head and 8.5” between the sides was sufficient to fit a wearer’s head through. The hole for the head is not equally split between the two halves of the helmet. Instead, a larger section of the hold is made on the front half of the helmet, so that the wearer’s ear approximately line up with the seam created by the flanges of the two helmet halves.
15. Using sharpie which can be removed with alcohol, mark the width distances and draw an approximate curve between them. It doesn’t need to be perfect. Separate the two halves from their temporary clamping to cut out the head hole using scissors. Do not rush so as to create sharp or

jagged edges which can harm the wearer when they lower the helmet onto their head. This is also a good time to trim the flanges to a consistent length from the dome portion of the helmet.

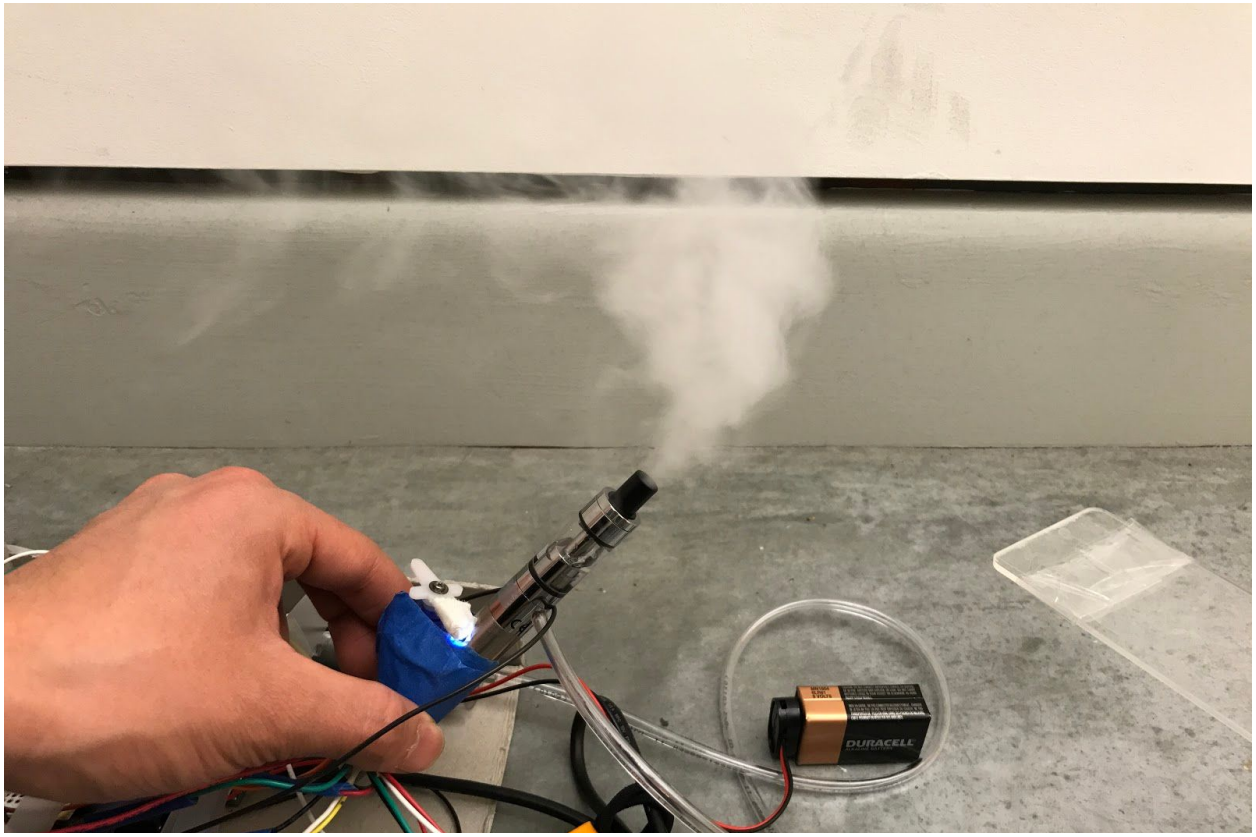
16. Making sure the inside of the two helmet halves line up, temporarily clamp the two halves again using binder clips or small bar clamps. Mark out with sharpie on the flange where the hardware will be located, keeping each location equidistant from each other. Use used 4 screws in each quadrant of our helmet. With the exception of the missing flange from the head hole, we used 11 screws and nuts along the flange total. Make sure two of these screws are located near the edge of the hole for the head.
17. **(Note: Before installing the LEDs, please follow the instructions in "Lightning Simulation" and ensure that basic lighting works.)** The LED strip is mounted similarly to how the vinyl fabric is sandwiched between the flanges. Line the inside of the helmet seam with the LED strip, arranging it so it is centered between the left and right sides of the helmet. On the LED strip, temporarily mark with tape where it overlaps the hardware. Remove the LED strip from the inside of helmet and wrap the marked locations with "tape string" and tuck the ends between the helmet flanges like the vinyl. To create the tape string, take a strip of clear packing tape and fold once over itself so that no adhesive is showing. This way the tape string will not stick to the LED strip.

18. Use an electric drill to create holes for each screw. Use clamps to prevent the helmet halves and vinyl from moving after they've been lined up. Additional hands may be needed to stabilize the flexible plastic flange. After the holes are drilled, pull the tape string to secure the LED strip and insert and tighten the hardware. Trim any mismatched flanges, vinyl, or tape string until all edges are uniform.
19. Cut a sufficiently long strand of insulated wire, preferably white. Guide it from the switch on the hatch to the seam at the middle of the helmet and along the seam until it reaches the head hole. It can also be secured inside the tape string used to secure the LED strip.



20. To prevent the helmet from drooping on the wearer's head, the helmet is secured to the wearers back through a rigid piece of acrylic. Using a laser cutter cut out a long rectangle with slots at one end out of ⅛" acrylic using Helmet mount.ai.
21. To create a bend approximate 2.5" from the top of the acrylic piece, lay the acrylic on a strip heater, with the portion to be bend above the heating element. Wait for the the acrylic to become sufficiently heated until bending to just less than 90 degrees. Constrain the non bend portion of the acrylic by clamping it with a extra piece of flat rigid material. Make sure to account for spring back.
22. Mark out and drill two holes at the base of the back half of the helmet, near to the head hole, and attach the bent acrylic piece once cooled.
23. Make sure to remove any sharpie markings with alcohol before moving forward.

24. Two types of batting, a more uniform sheet and non-uniform clumps, line the back half of the helmet to create a cloud effect and help disperse the LED light. Start with the more uniform sheet of batting and allow it to drape the inside of the back half of the helmet. Line the edge of the back half of the helmet where the dome meets the flat surface with hot glue and press the batting into the edges to secure. Wrap the edges of the sheet batting under and over the LED strips to secure to the seam of the helmet.
25. Scatter the non-uniform clumped batting along the back half of the helmet over the sheet batting. When satisfied with how it looks, glue down and secure with hot glue.



FOG

Materials Required:

- Kanger TOP EVOD electronic cigarette
- Vegetable glycerin
- Blue painter's tape
- SG90 9g micro servo
- Microcontroller: Arduino Uno
- Mitsumi R-14 A213 370 DC pump
- Clear tubing
- Electrical tape
- Clear tubing of a thicker diameter to fit around the vape mouthpiece (a boba straw will also do nicely)

Tools Required:

- Soldering Iron
- Electric drill

Instructions:

1. Acquire a new electronic cigarette. (Using an old e-cigarette will mean working with cotton wicks that have been contaminated with nicotine or other addictive substances, which is bad for your health.) As per your e-cigarette's instructions, fill the tank with pure vegetable glycerin and allow the cotton wick to soak up the glycerin for 15 minutes.

2. Find the airflow channels on your e-cigarette (for our particular brand, there are three holes around the base of the heat coil, as pictured above) and carefully use an electric drill to enlarge the opening of one of the holes. This will allow the air pump to push air into the opening and produce greater quantities of smog.
3. Attach clear tubing to the valve of the small air pump and use tape to create an airtight seal between the other end of the tubing and enlarged air flow channel.

4. Use tape again to create an airtight seal between the mouthpiece of the e-cigarette and the boba straw. The boba straw will be inserted into the helmet through the head hole. Air should now be able to flow from the air pump, through the tubing, into and through the e-cigarette, and out of the boba straw.

Automating the Fog:

1. Upload **autopress_on_off.ino** to your Arduino Uno.

2. Using tape, attach the servo so that its wings are in a position to reliably press down upon the vape's on button. This may require a bit of trial and error with the Arduino.
3. To connect all the components, please follow the wiring guidelines provided in "Assembly and Wiring."

LIGHTNING SIMULATION

Materials Required:

- Neopixel LED strip
- Microcontroller: Arduino Uno
- Insulated wire
- Solder
- Flux pen

Tools Required:

- Soldering iron
- Hot glue gun

Instructions:

1. Solder colored wires to the 5V, GND, and data pins on your Neopixel strip. This may require the generous application of flux and a Third Hand, as Neopixels are notoriously difficult to solder onto. Secure the wires completely by dripping a line of hot glue on top of your soldering job.
2. Upload **lightning_simulation.ino** to your Arduino.
3. To properly wire the components, please follow the wiring guidelines provided in "Assembly and Wiring."

AUDIO

Materials Required:

- Small speaker
- Double-headed audio cable
- GoPro harness
- Microcontroller: Raspberry Pi
- Insulated wire
- ¼" plywood

Tools Required:

- Soldering iron
- Laser cutter

Instructions:

1. The small speaker is attached to a GoPro harness using the already-existing GoPro mount on the front. Laser cut two speaker braces out of ¼" plywood using soundbox-mount.ai. The braces should fit snugly over your speaker. Use the existing GoPro hardware to mount the speaker to the harness.
2. Put **methods.py**, **storment_launcher.sh**, and **pi_weather_player.py** in a folder called "storment" in the home directory of your Pi.
3. Move all thunder sound files into the /var/lib/mpd/music directory of your Pi so that mpc can access it. These sounds were taken from freesound.org and layered over the same ambient rain track, so that seamless randomization of the files was possible. You may add your own if you wish.
4. Using a cronjob, configure your Pi so that it will run **storment_launcher.sh** on startup.
5. To connect all the components, please follow the wiring guidelines provided in "Assembly and Wiring."

ASSEMBLY AND WIRING

Materials Required for Assembly:

- Helmet
- Fog
- Lighting
- Audio
- Backpack

- Portable power supply with two USB ports (or two 9V batteries)
- Raspberry Pi (from audio step)

Materials Required for Wiring:

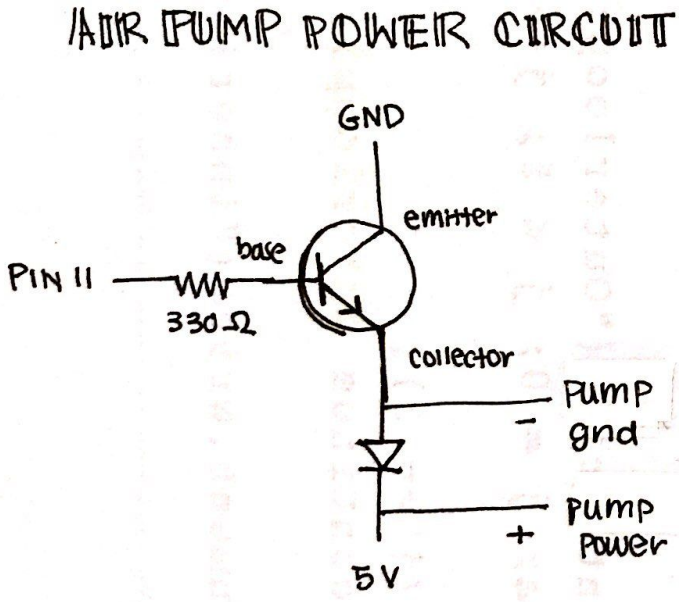
- Two Arduino Unos (from previous steps)
- Two Adafruit protoboards
- Male headers
- 330 Ohm resistor
- P2N2222AF19 transistor
- 1N4148 Diode
- Heat shrink tubing

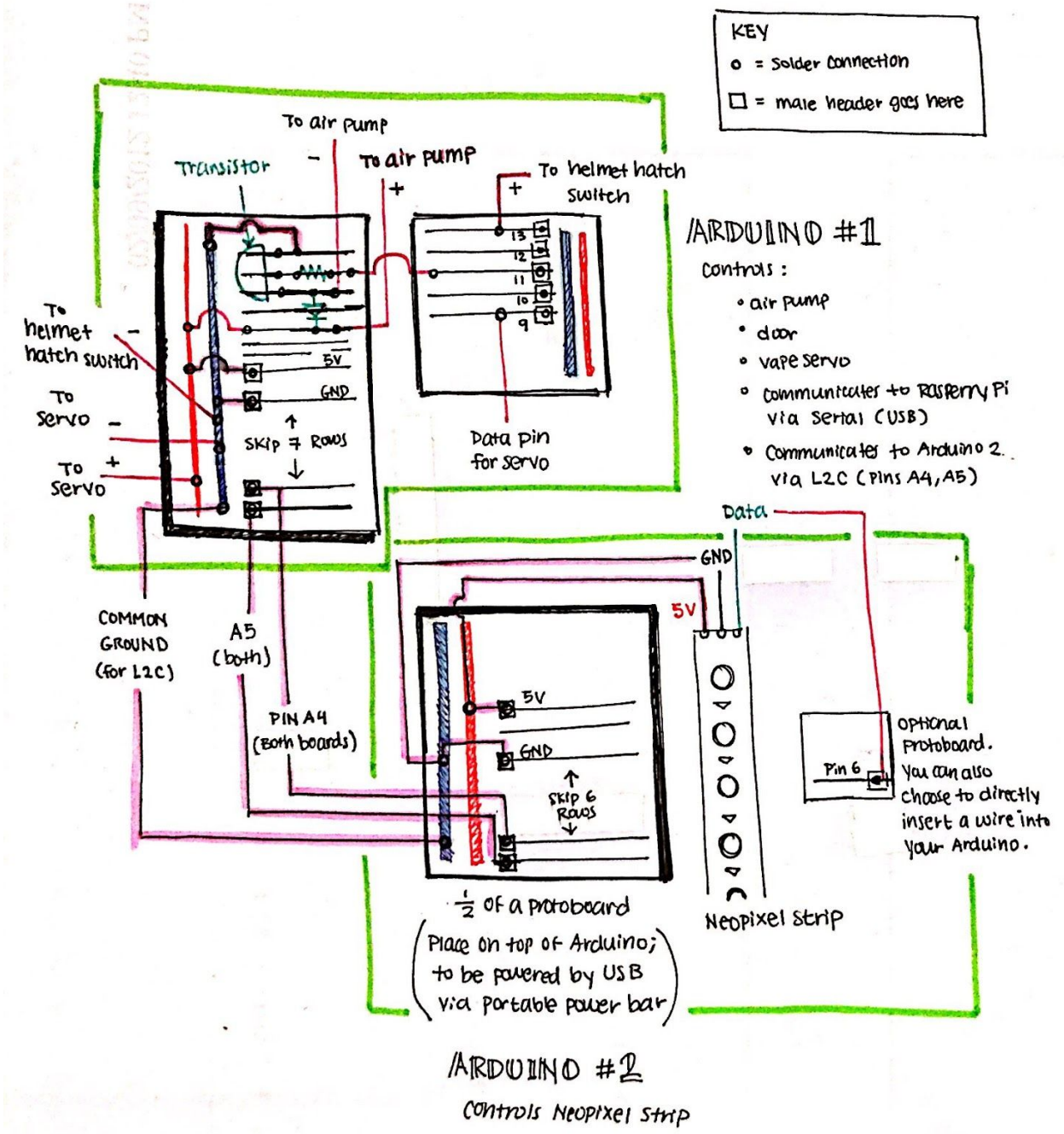
Tools Required:

- Soldering iron
- Breadboard cutter
- Heat gun (for heat shrink)

Wiring Instructions:

Using the protoboard cutter, split your protoboard into multiple halves as needed and solder according to the diagram below. When soldering wires to a male header, consider adding heat shrink tubing for extra stability. A close up diagram depicting the air pump circuit logic is also provided for clarity.





After all the components have been wired, power the setup by connecting Arduino 1 to the Raspberry Pi (note that depending on the port you use, you may need to change the serial port used in **pi_weather_player.py**), Arduino 2 to the power supply, and the Pi to the power supply as well, all via USB cable.

Assembly Instructions:

1. Place all electronics, power supplies, and e-cigarette into a backpack.
2. Have the wearer put on the speaker-attached GoPro harness.

3. Have the wearer put on the backpack while holding the tethered helmet about their head.
4. Lower the helmet over their head while ensuring that the bend acrylic bar is sandwiched between their back and the harness. If necessary, using additional tape string and a carabiner to secure the bend acrylic to their pant loops to prevent the helmet from drooping.
5. Take care to keep the helmet hatch open and the switch unswitched so that fog, lighting, or sound don’t start prematurely.
6. Plug in the audio cable from the backpack into the speaker.
7. Close the hatch to initiate the fog, lighting, and audio.