Microcontroller Vaporizer

by rabbitcreek

This is a Instructable on how to build a machine that vaporizes organic materials at a temperature of 500 F. There appear to be a few machines out there commercially available for this purpose but they have yet to undergo a renaissance of construction and design ideas. If Bang and Olufsen can make Bluetooth speakers appear desirable perhaps they should look at vaporizers that look too much like bedside medical devices. This design incorporates a couple nice touches--the first is using readily available and cheap($8.00) print heads for 3D printers that include a ceramic heater element and a thermistor all wired up to go. The vaporization chamber is clamshell approximation of two tea-candle bodies from Target. The final touch is more-fascinating-while-stoned servo that uses a Bowden cable to lift the lid up. A Bowden cable is the same device used to transmit power to your bike brakes--inner moving and outer stationary cable that was invented about 1900.

Step 1: Grab Your Materials

Material List

Glass Chamber --Tealight Holder Clear Glass 6 Count - Threshold™ Target.com ($6.00)

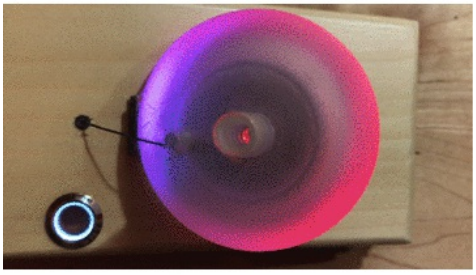
3D extruder head with

Feather non-latching relay board-- https://www.adafruit.com/product/2895 ($8.00)

12 v 2 amp wall wart--($10.00)

12v to USB dongle for car--($6.00)

Servo--($10.00)



thermistor--- https://www.amazon.com/gp/product/B01I4ZQU88/ref=oh_aui_detailpage_o02_s00?ie=UTF8&psc=1($8.00)

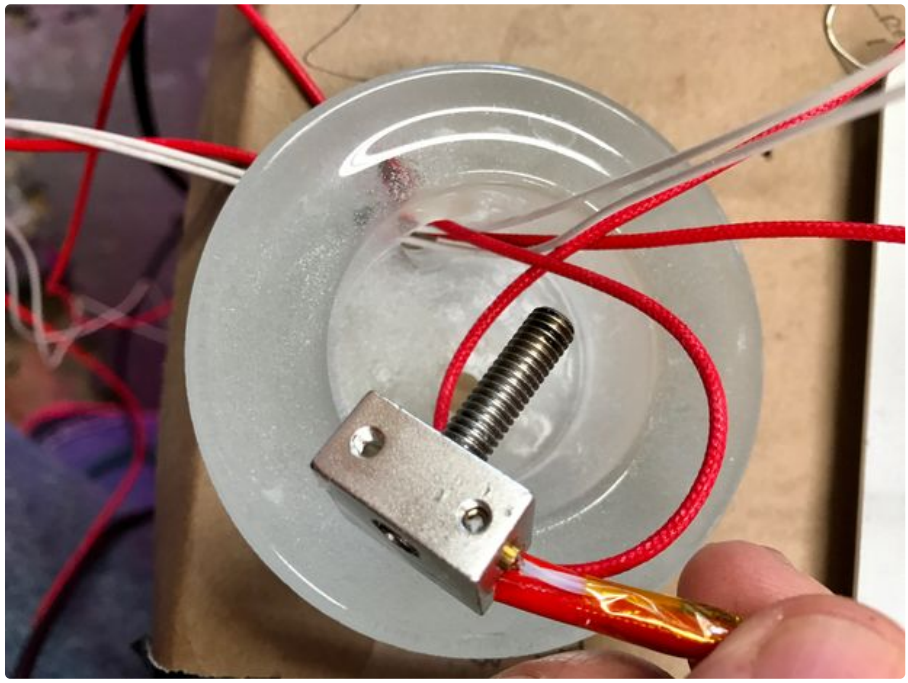
Feather 32u--basic board-- https://www.adafruit.com/product/2771 ($20.00)

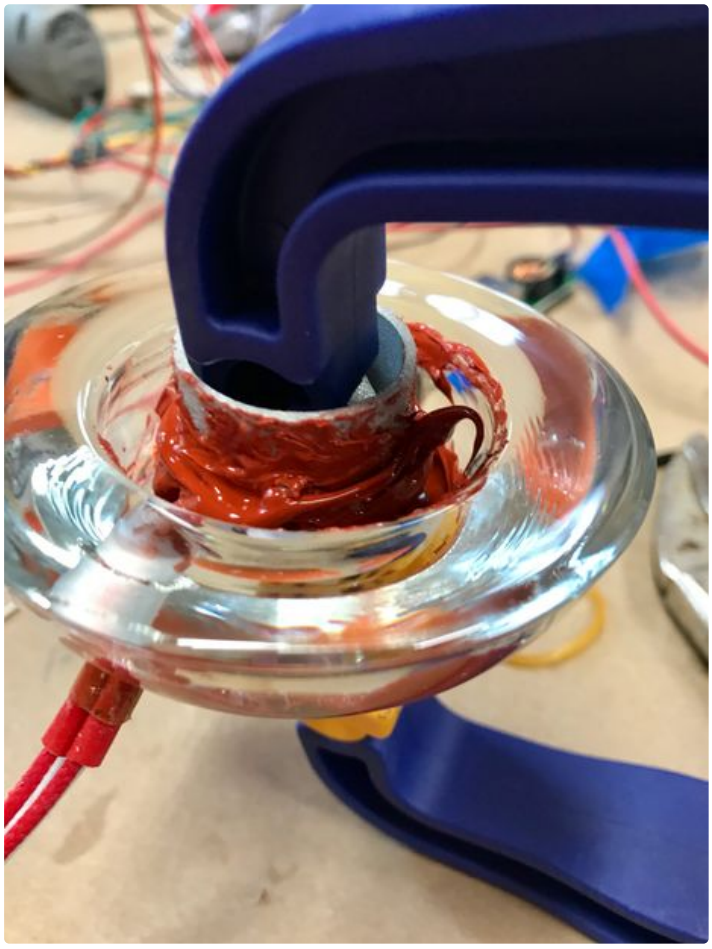
NeoPixel Ring - 12 x 5050 RGB LED with Integrated Drivers ($7.50)

Aluminum plate, aluminum tubing 1 inch, wood (poplar) sheet 6" Big Box and other various things...

Step 2: Build the Chamber

Working with glass is a lot easier than you think. These candle glasses from target are thick and forgiving and they're cheap if you mess up. I used them because you need some sort of chamber to build up the heat and vapor and provide an entrance for air and egress for the gas. The 3D print head is aluminum and comes with a brass tube and nipple designed to extrude the plastic. Remove the nipple and retain the brass tube to act as an air conduit for the vaporizer through the bottom of the glass bowl. Drill two holes in the bottom half of the sphere as shown in the first picture--one will accommodate the wires (thermistor and heater--4 wires) and the other is for air flow through. Drilling glass is easy with one of the newer bits that they sell at the big box store--do it under water per instructions and go slow. Drill two holes in the top sphere in the center and side to accommodate the gas exit straw and the attachment point for the cable. The extruder head is soft aluminum and you will have to round it slightly to fit inside the 1 inch aluminum tube that will stick up slightly above the bottom half of the sphere. The Aluminum heating chamber is then cemented into place with High Temp Silicon Gasket cement (Permatex) . Make sure you have the brass tube trailing out the bottom to provide the airway --you can remove this when silicon is partially set. Make sure the wires are encapsulated too. To fully encapsulate the silicon I filled the remainder of the space with Quikrete with black pigment. The two halves of the sphere were put together with a small hinge held in place with Silicon after flattening the edge with a glass burr. The outside of the chamber was sandblasted, but honestly you can use the frosted glass spray paint they sell in the big box store too.





Step 3: Build the Electronics

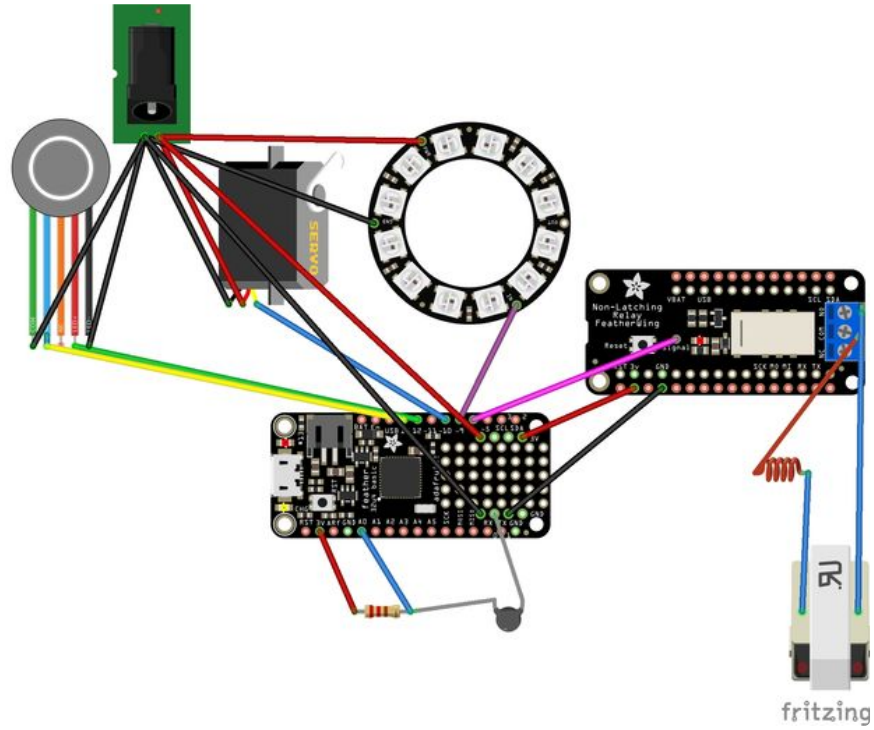
The electronics are relatively simple. You have three parts.

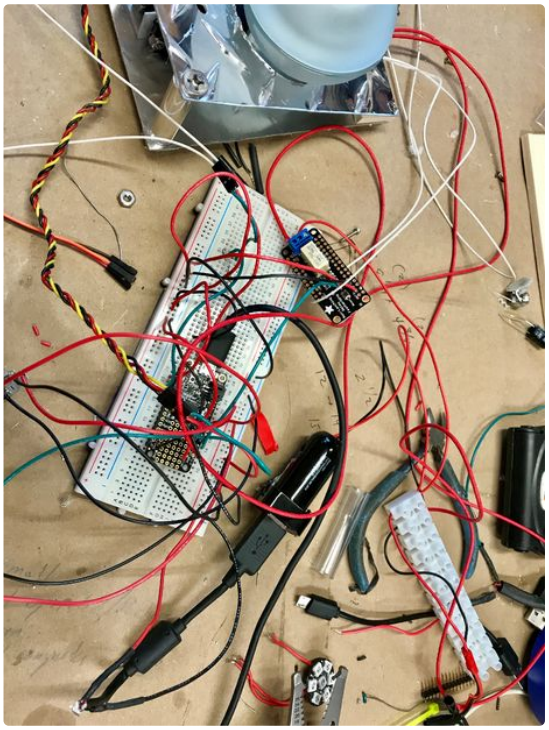
1. Thermostat: Go to the Adafruit learning center and look up what they have to say on thermistors. It is a wonderful and detailed explanation and I used quite a bit of their software. There is a good reason to buy things from this wonderful company--they seem to invest a lot of time and resources helping design these fun things. The thermistor in the 3D print head is 100,000 K and the paired resistor in the voltage divider was a 10,000 K to provide the correct range for the temperature wanted. All the rest of the constants are in the software. Obviously try out the heater with the thermistor through the serial port and make sure it is reading the correct temperatures. Go through the examples with the programs listed just to make sure both are working correctly. The software queries the thermistor about once every 5 seconds and either turns the relay on or off. The obsession most people have with temperature control in these devices is a little misplaced. Even with the thermistor accurately judging the temperature the real temp measured with the infrared thermometer can be 50 degrees off on the surface of the organic material depending on packing. You have to stir the stuff around on the plate to get it all up to temp. The power supply for the heater unit comes directly from the 12 volt 2 amp wall wart through the relay. It also powers a cheap car 12v to USB power supply wart that is used to drive the neopixels and the servo as well as a separate supply to drive the computer and relay boards.

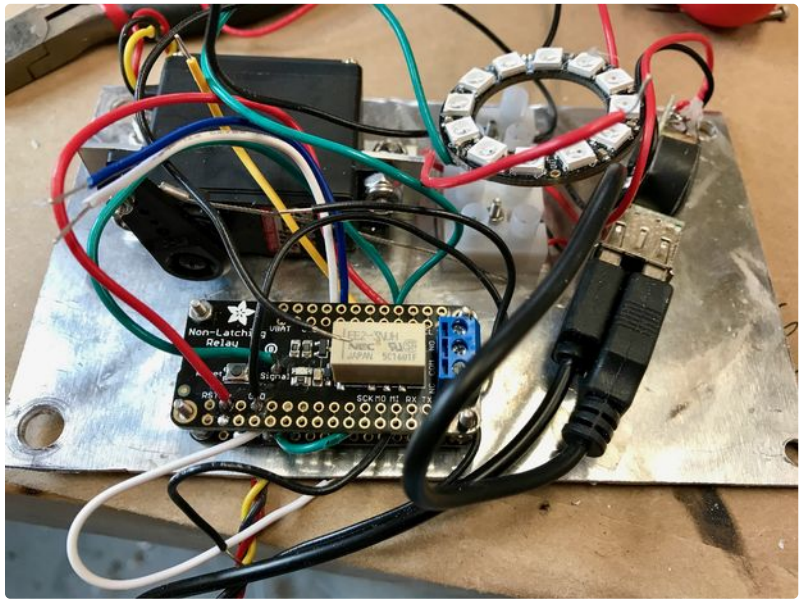
2. Neopixels: The neopixels are programmed initially to glow green off/on until the button is pushed to close the chamber. Their color is then linked to the thermistor output to get a reading on the temperature--blue cold to red hot. They are then switched to a neopixel fire script when the temperature hits target. When the button is pushed to turn off heat it switches back to green.

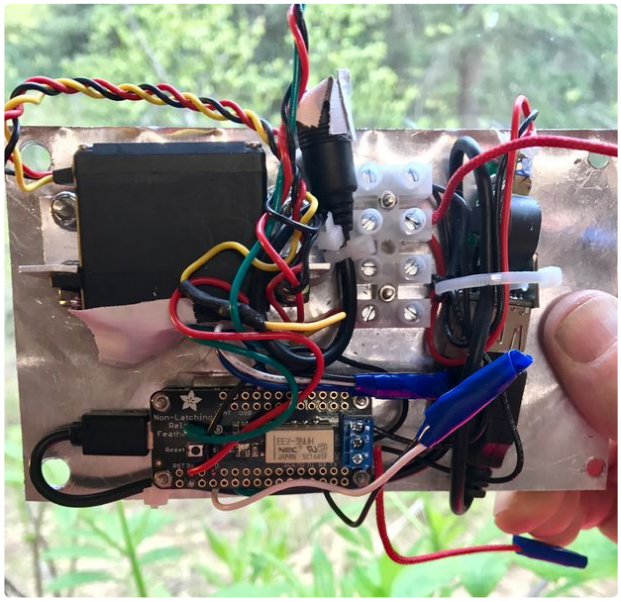
3. Servo: This is powered with the neopixels with a separate line from the car USB wart.

The fritzing diagram is included above. As before try out everything on a breadboard first.


SERVO
Non-Latching
Relay
FeatherWing
fritzing







Step 4: Software

The software is included below. Notice that it uses the new servo library from Adafruit that does not cause conflicts between neopixels and servos. This is a real problem if you do it the old way with the servo constantly making angry spasm noises while it should be quietly contemplating the nature of the universe. The Temperature is set in the initial section as listed. The relay pins and servo pins are also easily changed. The bulk of the software is devoted to the fire sketch and can be eliminated or reduced for simplicity. When building the cable for the servo lid lift you will have to adjust its position in the software for high and low as listed. This is a trial and error process having to do with how the cable is aligned and attached to the servo horn.

The program is designed to go through a certain number of fire cycles before shutting down the relay and stopping the device as a safety failsafe to prevent unattended heating.

Download (https://cdn.instructables.com/ORIG/FD7/XXMC/J3EPRSTQ/FD7XXMCJ3EPRSTQ.ino)

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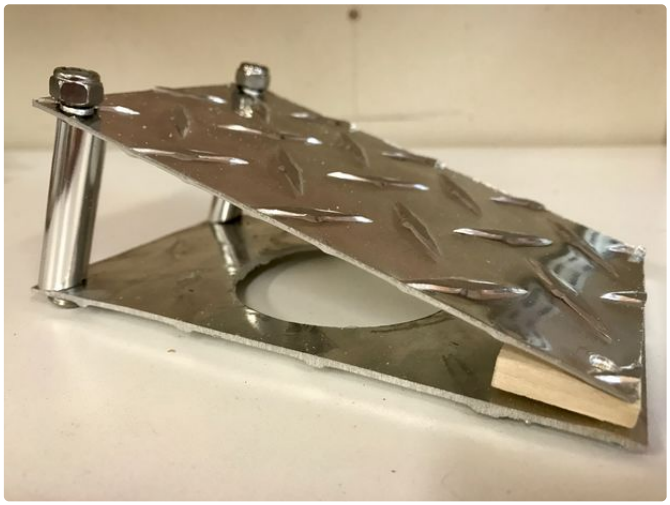
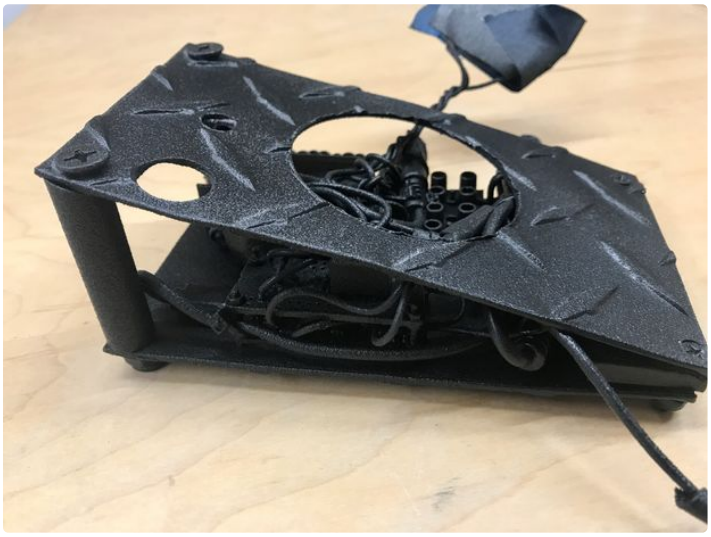
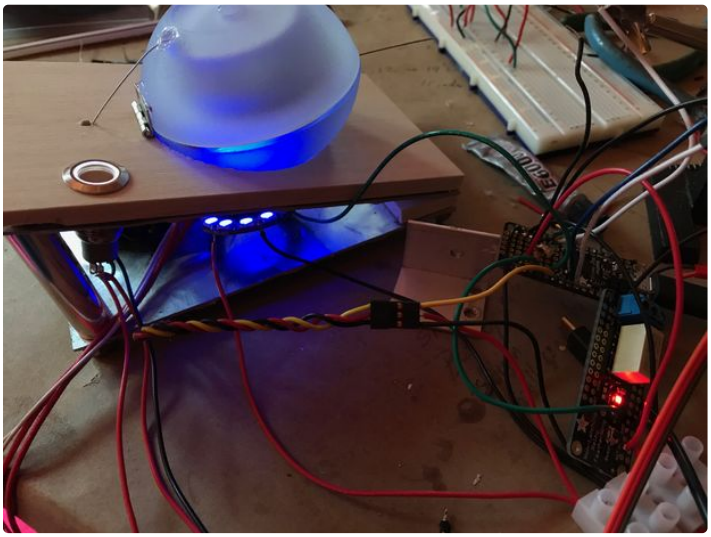
Step 5: Build It

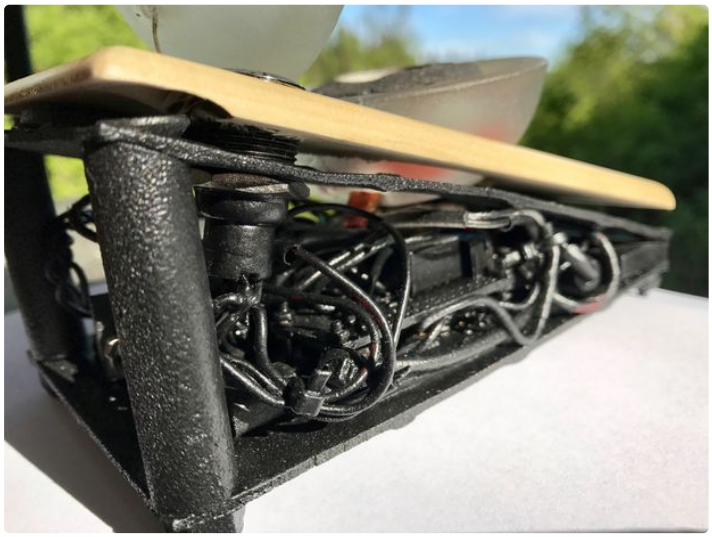
I built the main unit out of aluminum diamond plate with a 3 inch hole for the sphere in both the underlying metal and the wood above. Supporting pillars of aluminum with underlying bolts provide the triangular shape. The feather and its corresponding relay board are mounted above one another with the positioning of the servo being most important in the underlying structure. The Bowman cable was a section of bicycle brake housing that was placed through the plate and wood--the internal cable was actually a repurposed fishing leader cable. The internals were all bolted to the frame with small bolts.

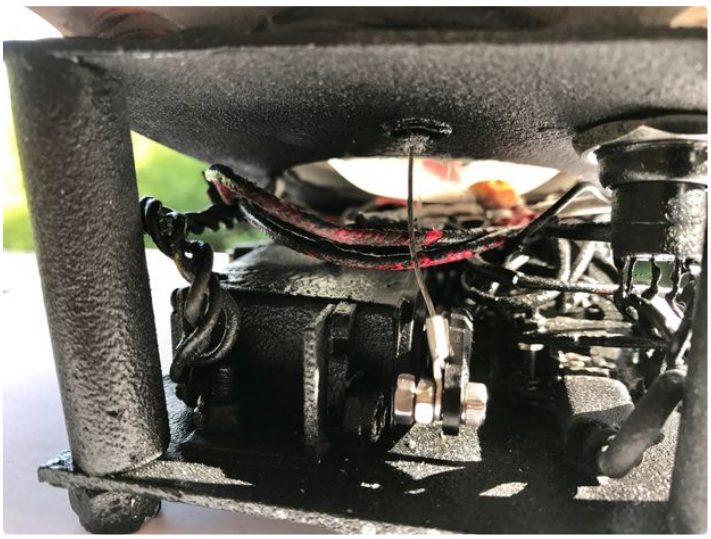
Make sure the USB port on the feather is available for programming and serial port monitoring after mounting. The Neopixel ring was placed far enough away from the bottom of the sphere so heat would not be a factor. Be careful with your arrangement of electronic components as the sphere will eventually transmit the heat. Most parts like the sphere were glued into position with E6000 glue. Painting of the electronics parts was done with black spray truck bed liner plastic. Finishing of the wood edges was done with a router and finished with poly.

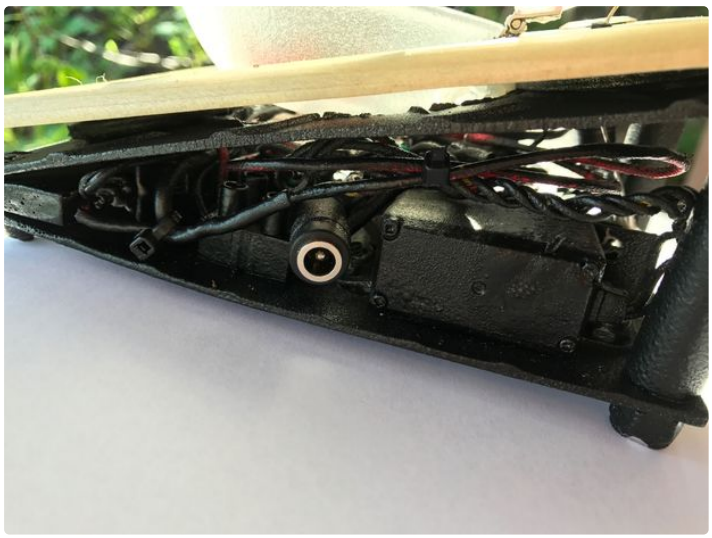






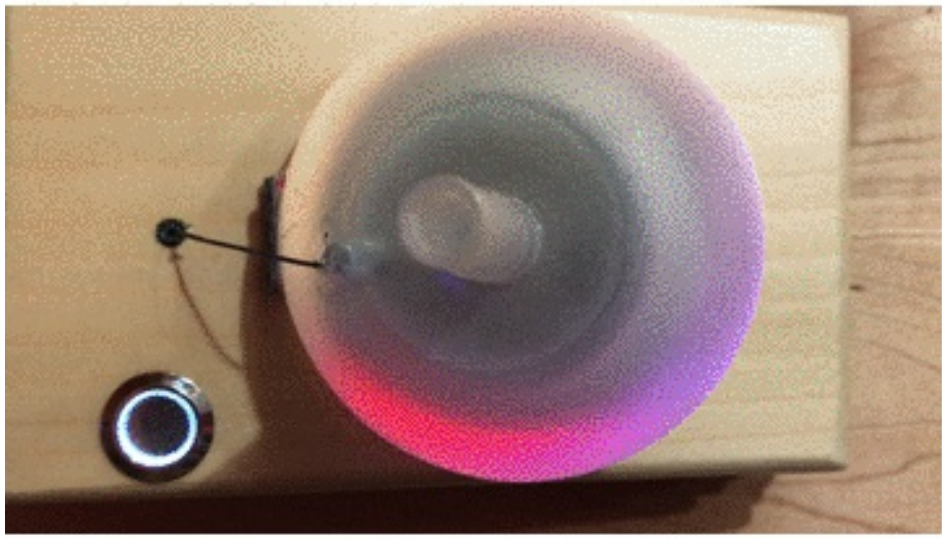






Step 6: Use It

Its a pretty cute device. I built the nice fork to stir up the organic material over the heater plate. A small stainless steel screen goes over the extruder block and keeps stuff from falling down the air inlet hole. You can use a small silicon extension tube from the outlet or not. It heats up to temperature in about 3 minutes and maintains the set temp within about 25 degrees for as long as you want. The failsafe in the software will shut it down automatically in about 20 minutes of use.



looks awsome!