Bucknell
UNIVERSITY

DAMNED Project Assembly

Assembly instructions for the Feather M4 Express-based IoT device used to visualize a public data stream from Thingspeak in conjunction with local sensors.

Written By: Matt P. Lamparter

**This document was generated on 2023-10-17 04:43:37 AM (MST).**

INTRODUCTION

This guide will walk you through the steps of assembling a DAMNED device. You will be provided with the BOM (bill of materials) and the guide will explain each step of assembly. This guide assumes you have completed all prior steps of 3D printing and laser cutting parts and soldering components to the PCB.

Step 1 — Confirm parts

Quantity	Description
1	stepper motor
1	stepper peg (small disc, 3D printed)
2	motor mounting bolts (small, black)
3	diffuser mounting wood screws (silver, pointy, flat head driver)
3	PCB mounting bolts (long, silver)
3	spacers, 7/32" long, 3/16" OD (black, plastic)
5	hex nuts
1	hex driver, 3/32"
1	screwdriver, flat 2 mm
1	acrylic diffuser (with paper covering)
2	washers to mount motor
3	single female headers for NeoPixel ring mounting
1	NeoPixel ring (24 RGB LEDs on a circular PCB)

- Confirm you have everything on the bill of materials (BOM).

- In addition to these parts you will need the items you assembled during the previous Design Assignments:
  - Populated PCB
  - 3D printed pieces including the shell front, shell back, and motor arm
  - Laser cut pieces including the LED ring base, ring mount bottom, ring mount top
 - Feather M4 and power supply

Step 2 — Mount motor
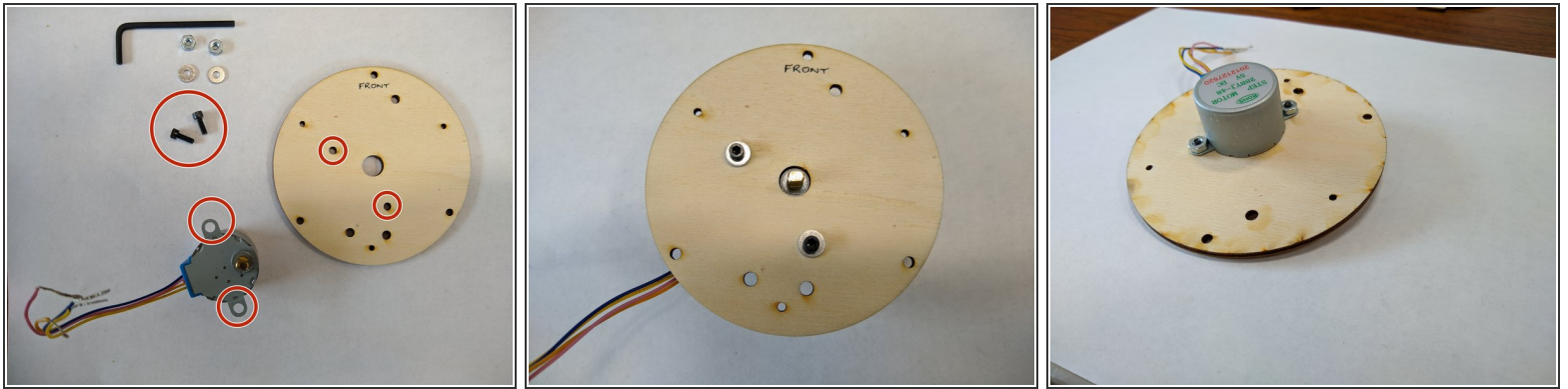
- Begin by locating the wooden LED ring base, the 4-40 x 1/4" bolts, two nuts, two washers, and the stepper motor.

- Insert the motor shaft from the rear of the LED ring base (side without text) so that the housing flanges are flush against the wooden base. Line the mounting holes of the motor up with the holes on the wooden base.

- (i) **Make sure the hole pattern of your board matches that shown in the example! Otherwise parts will not line up in future steps.**

- Insert the two bolts from the front of the LED ring base through the motor mounting holes. Use a washer between the bolt head and the wooden base.

- Secure the bolts with the provided nuts. You will need a 3/32" hex key for the bolts. You can use either a pair of needle nose pliers to hold the nuts or a 1/4" nut driver.

Step 3 — Align NeoPixel headers with PCB
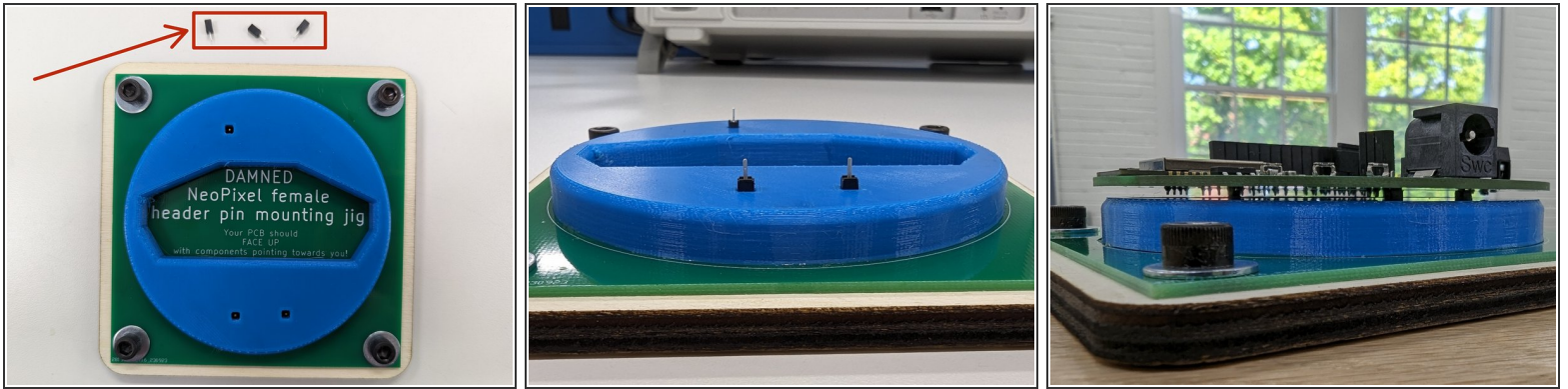
- Locate the NeoPixel header soldering jig in the Maker-E. It should be on the soldering bench in the same location where the jigs for stenciling paste for the DAMNED and Bucknell B PCBs are located. Also ensure you have the three single headers you will need to solder to your PCB.

- Place your three single female headers on the three pins of the jig. Press them down until they just sit on the pins. You should feel a slight click. The properly seated pins should look the same as the second image here.

- If have you have not done so already, use flush cutters to clip the leads from your terminal blocks close to the PCB. This will prevent any offset from occurring during the next step.

- Line up the headers on the jig with the three holes on the **back** of your populated PCB labelled: DIN, 5V, GND.

- Carefully press down on the PCB with the bottom side facing the jig until the pins protrude through the three corresponding holes on the top side of the PCB. Your PCB components should be facing up towards you. The board should sit level on top of the three pins.

Step 4 — Solder NeoPixel headers to PCB
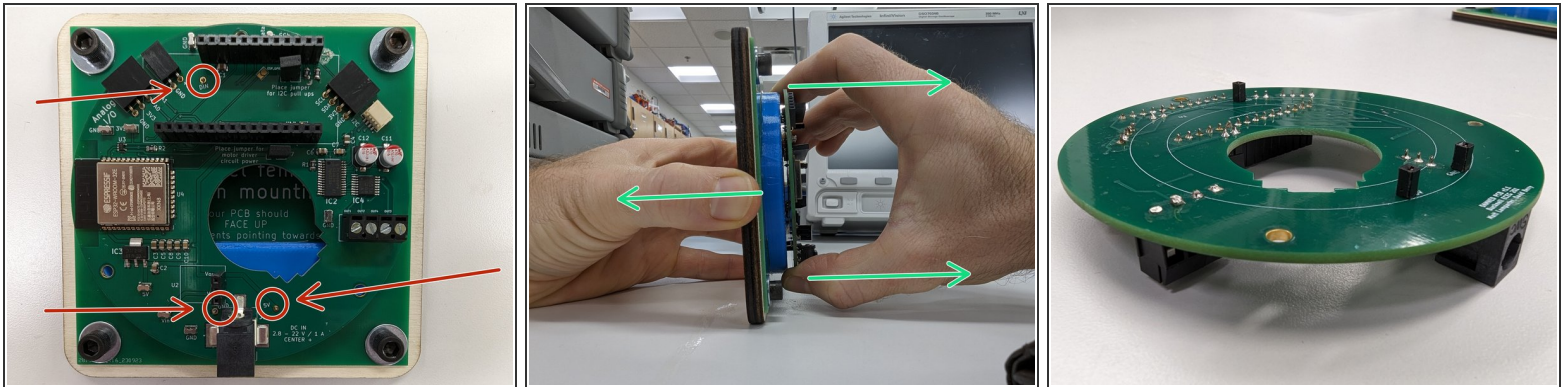
- With the three pins properly aligned with the PCB holes (DIN, 5V, GND) and the pins protruding slightly, proceed to solder the pins in place.

- ⚠ Be careful not to melt or damage any of the surrounding components! It is easy to bump the hot soldering iron against a nearby plastic connector.

- When soldering is complete, use gentle, even pressure to pull the two pieces apart. **DO NOT ROCK THE PIECES BACK AND FORTH.** Rocking back and forth can damage your PCB or the jig.

Step 5 — Apply glue to mounting rings

ⓘ This step involves using glue. **You must either work on the blue/grey soldering mats in the Fabrication area or else use cardboard or other protective material (white craft paper) to cover benches or tables elsewhere in the Maker-E. Failure to do so can cause damage to work surfaces and may result in Maker-E access revocation.**

- Find wood glue in the yellow DeWalt cabinet. Also get a small piece of wire to apply glue and a piece of cardboard or other scrap material to hold glue.

- Locate the two wooden mounting rings. Apply a thin layer of wood glue to the **back** of both rings. The back is the side without any writing.

- Layer the three wooden pieces as follows:

  - Begin with the LED ring base. The side with the bolt heads and motor shaft should be facing up.

  - Next, lay the bottom mount ring on top of the LED ring base, glue side down. The word **FRONT** should be facing up.

  - Finally, lay the top mount ring on top, glue side down. The **ECEG 201** should be facing up.

- Your stack up should look like the final image shown here. Be sure all three of the mounting holes in the tabs line up.

Step 6 — Mount PCB on LED ring assembly
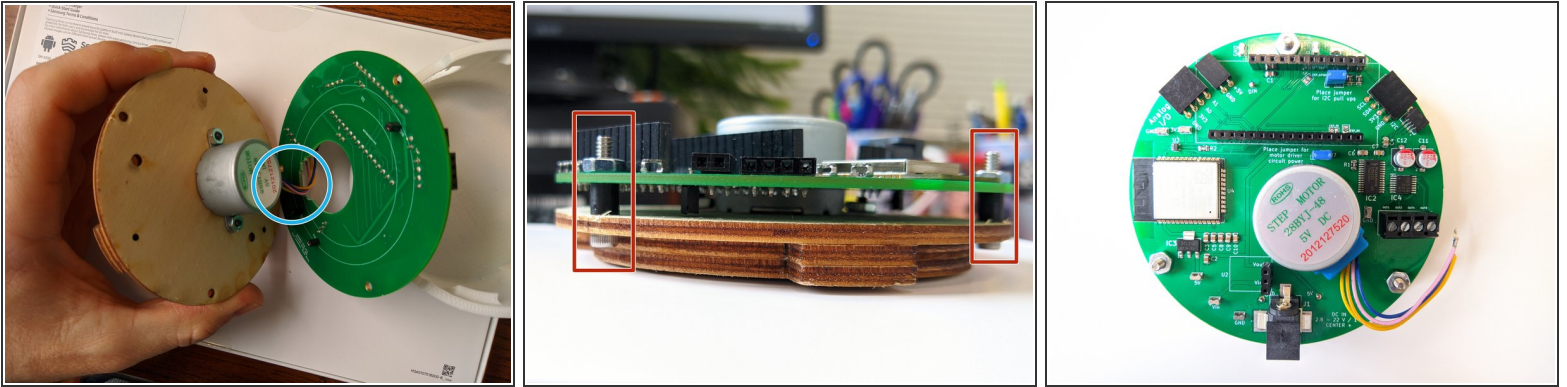
- Line the PCB up with the wooden LED ring assembly. The back of the PCB (with NeoPixel headers) should face the back of the LED assembly (with motor body).

- Be sure that the notch in the offset center hole of the PCB lines up with the motor and motor wires. Gently pull the four motor wires through the notch as you lower the PCB down over the motor. This is called out in blue in the first image.

- Carefully lower the PCB down towards the wooden LED assembly. Continue to pull the motor wires up through the cutout notch so that they do not get tangled, bent, or kinked between the wooden base and the PCB.

- Once the PCB is resting on top of the LED assembly you will need to secure it with three bolts of size 4-40 x 1/2". Add a black spacer between the wooden base assembly and the PCB in conjunction with each of the bolts.

- Pass the bolt through from the front of the wooden base assembly, through the black spacer, so that the end of the bolt protrudes from the front of the PCB. Secure the bolt with a nut. You will need a 3/32" hex key and needle nose pliers or a 1/4" nut driver.

- You may find it helpful to use a pair of needlenose pliers or tweezers to hold the plastic spacer in place until the bolt goes through. Then loosely add a nut on the end end, but don't tighten. Do this for all three bolts + spacers + nuts.

- Once all three bolts/spacers/nuts are in place, tighten all three.

Step 7 — Connect motor wires and mount Feather
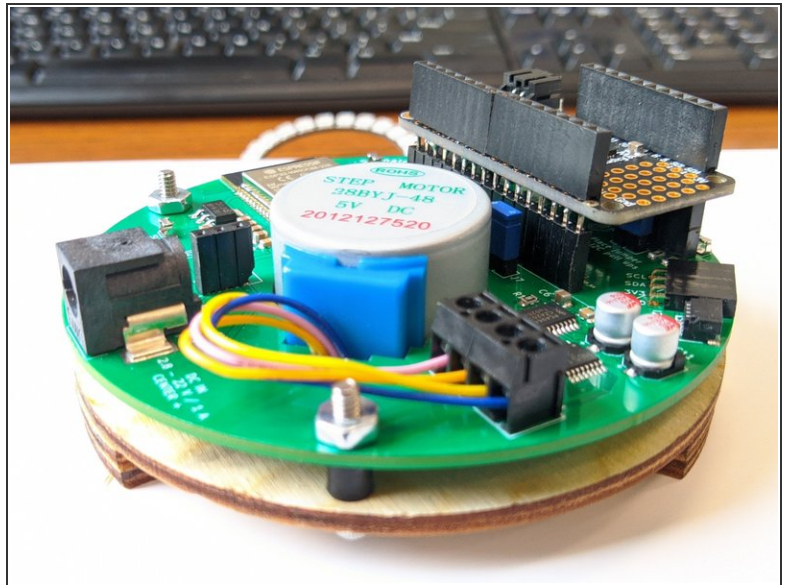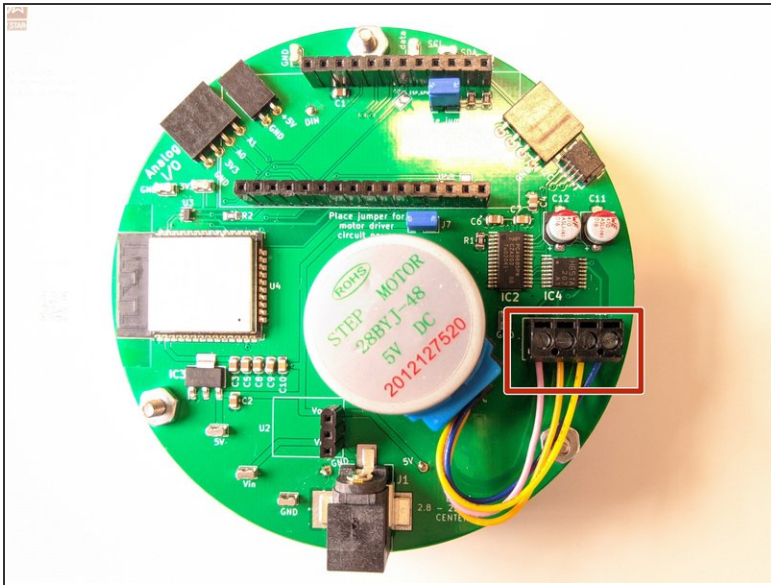
ⓘ You may need to strip some insulation from the ends of your motor wires. If no metal wire is exposed, use a pair of wire strippers to remove about 1/4" of insulation. Twist the ends of the stranded wire into a tidy bundle.

ⓘ While not necessary, it is good practice to tin the ends of stranded wire. This video has a nice example of how to do that. It is an extra 10 minutes worth of work up front that will save you from potential headaches in the future.

● Route the four wires from the motor and secure them in the terminal block as shown here in this order from left to right: pink, orange, yellow, blue. Use the flat blade screwdriver to secure the wires.

● Carefully place the Feather board on top of the mounting headers on the PCB. Be careful to line all of the pins up properly. Gently push down until the board is fully mounted on the PCB. **Failure to line up pins can cause them to bend and break.**

Step 8 — Attach NeoPixel ring
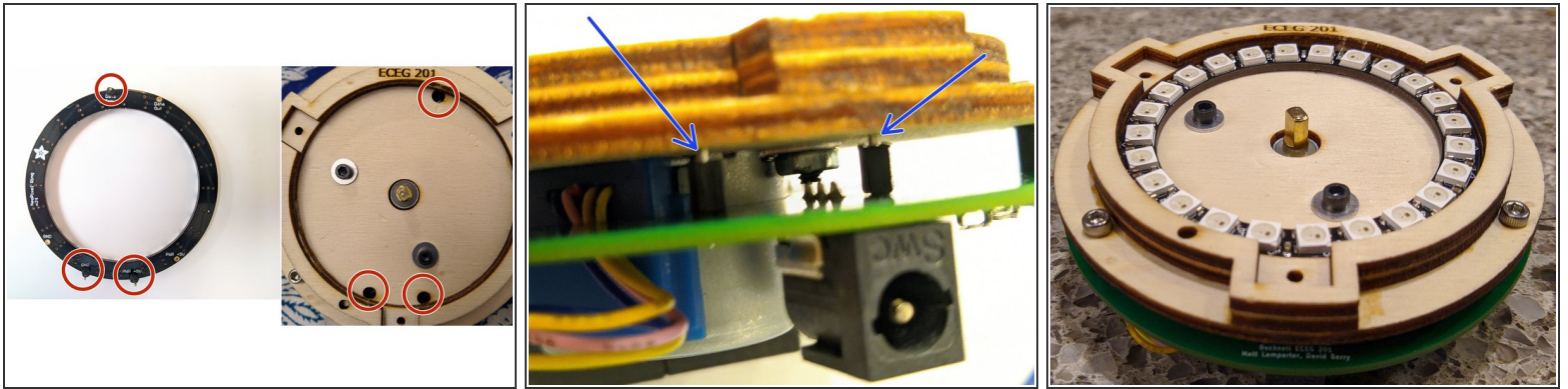
- Locate the three male pins on the back of your NeoPixel ring. These three pins need to be lined up with the three holes on your wooden LED base.

- Place your NeoPixel ring on top of your wooden base, pins inserted through the holes. Be sure to carefully line up the pins with the female headers on the PCB.

- Before you push down on the NeoPixel ring, be certain that your pins are aligned with the female headers. You may need to use a small tool like a fine pair of needle nose pliers or a small flat blade screwdriver to help you align all three pins.

- Once you are certain all three pins are aligned properly, push down on the NeoPixel ring. The pins should insert into the headers and the ring should sit flush against the wooden base.

This document was generated on 2023-10-17 04:43:37 AM (MST).

© 2023   bucknellmakers.dozuki.com/   Page 10 of 14

Step 9 — Mount acrylic diffuser

- Locate the acrylic diffuser and the three wood screws (pointy ends). You will also need a flat blade screwdriver.

- (i) Note that you may have to remove a protective film from one or both your acrylic diffuser.

- Use the screwdriver to screw the three screws through the holes in the diffuser into the plywood. The holes in the plywood are undersized so you will need to use a little pressure when driving the screws to cut threads into the plywood.

- Be sure to securely hold the three plywood layers together as you tighten the screws. If gaps appear while you are tightening the screws you will need to back the screws out, re-clamp, and then tighten the screws again.

- When you are finished with all three screws the acrylic should sit flush against the plywood rings and the there should be no gaps between the plywood.

Step 10 — Mount PCB assembly in shell front
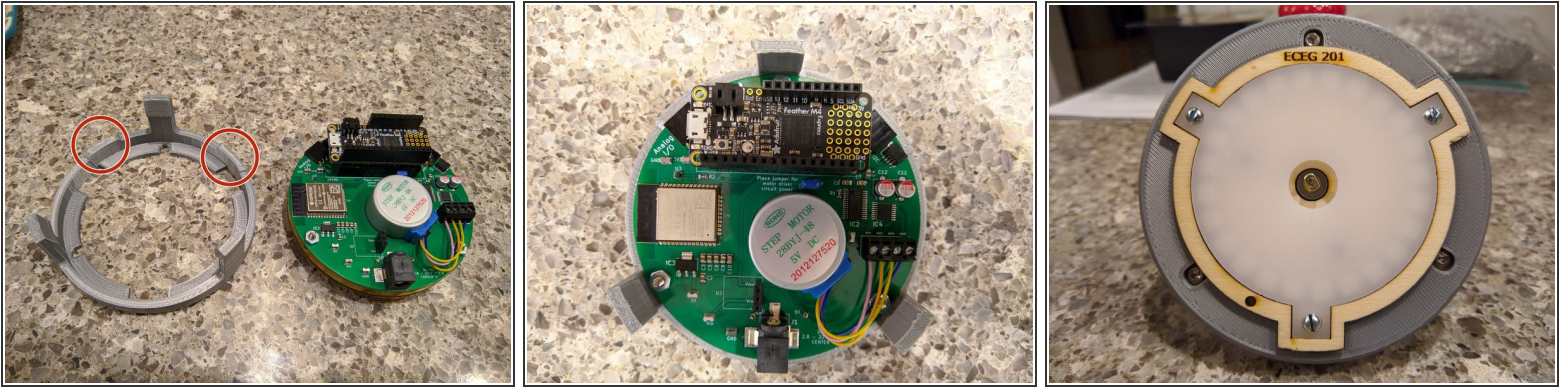
- Locate the 3D printed shell front. Orient the shell front such that the two short tabs are at the top. These tabs are circled in red in this image. Orient your PCB assembly as indicated here as well.

- Gently insert the PCB assembly between the three protruding mounting tabs on the shell front. You will have to bend the three tabs slightly. They are meant to flex to accommodate this assembly.

- Adjust the PCB assembly until the three bolt heads protruding from the front line up with the three notches in the 3D printed shell.

- (i) Note that the notches are not evenly spaced so there is only one correct orientation.

- When you are done the PCB should be nearly flush with edge of the case. The wooden rings of the PCB assembly should protrude from the front of the shell.
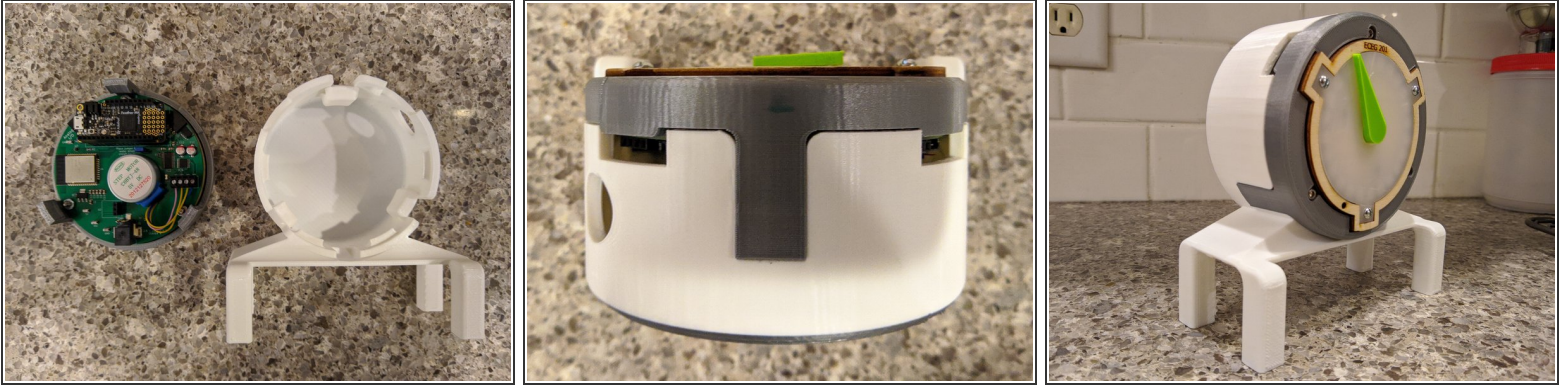
Step 11 — Add face components
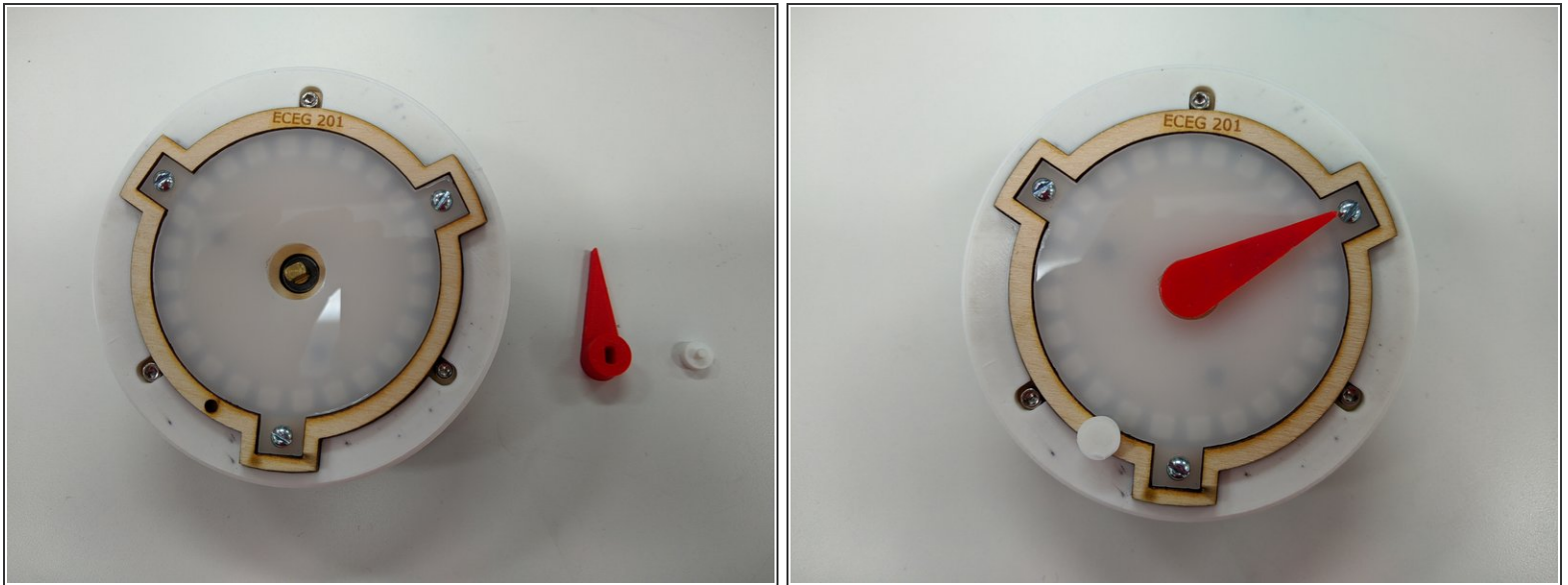
- Locate the 3D printed motor arm and motor stop pin.

- Insert the pin in the small hole near the bottom left of the LED ring assembly. You may need to carefully remove a bit of plastic if the pin will not fit in the hole.

⚠ Use caution when using a sharp blade to shave down the pin! Consider placing the peg in a vice (in the Maker-E or Mooney) and carefully shaving it down.

- Press the motor arm on top of the motor shaft in the center of the acrylic diffuser. You may need to use a bit of force to press fit the arm onto the shaft.

ⓘ If the arm is difficult to secure you can remove the PCB assembly from the shell front and place it flat on a surface (with the motor back flat against surface). This will provide you with a rigid surface to press against while attaching the motor arm.

This document was generated on 2023-10-17 04:43:37 AM (MST).

© 2023   bucknellmakers.dozuki.com/   Page 13 of 14

Step 12 — Connect shell back

- Locate the 3D printed shell back.

- Line the shell back up with the shell front. Rotate the back until the three tabs on the shell front align with the slots on the shell back. The **ECEG 201** text should be at the top of the shell front assembly.

- (i) Note that the tabs are not evenly spaced so there is only one correct orientation.

- Push down on the back until all three tabs snap into place.

- Congratulations! You are done assembling the DAMNED device!

- (i) Note that if you need to separate the two halves of the case you can use a flat blade screwdriver to pry the three tabs loose and pull the front from the back shell.