Building A Star Wars Astromech Droid

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By Eric Banker

Deciding What To Build R2D2 or...

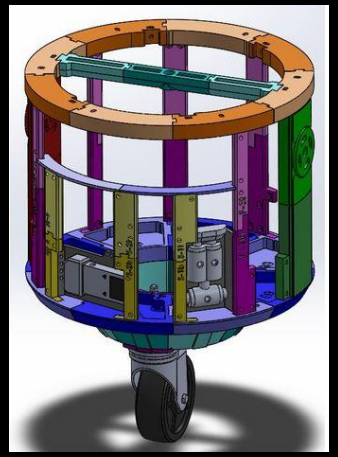
Choosing

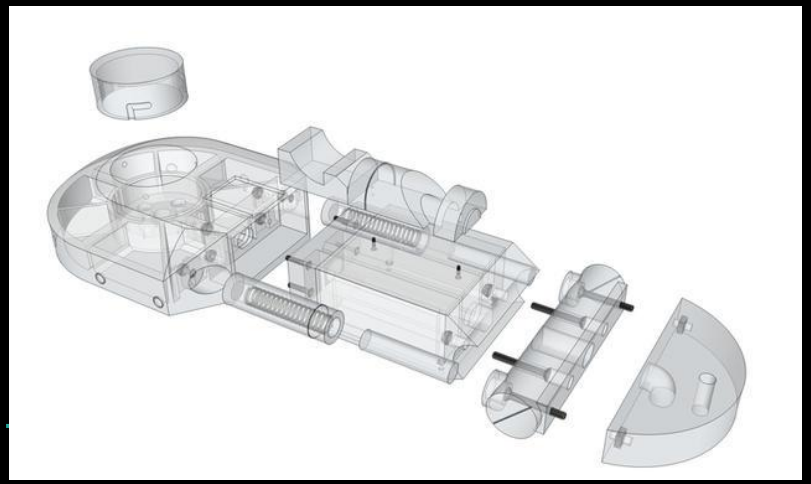
1. Started my research at Astromech.net
2. R2 is very popular with extremely well designed 3D printer files available.
3. R2 has some issues though like being prone to tipping
4. Chopper is shorter and more stable
5. I plan to take the droid out for Halloween. R2 doesn't do so well on streets and sidewalks
6. NO CHROME :)
7. There are between 400 and 500 finished R2D2 droids in the world. Less than 10 finished Choppers.

R2D2 C1-10P

Challenges

1. Since Chopper is not as popular there are not many sources for 3d files
2. Dome/leg files from one designer. Body from another. Combining them is a challenge
3. Lots of parts and standards out there for R2. With chopper I'll be doing a lot more design work (Positive for me)
4. Most of Chopper and R2 parts don't fit my printer. I had a lot of splitting to do for my Monoprice Maker Select v2

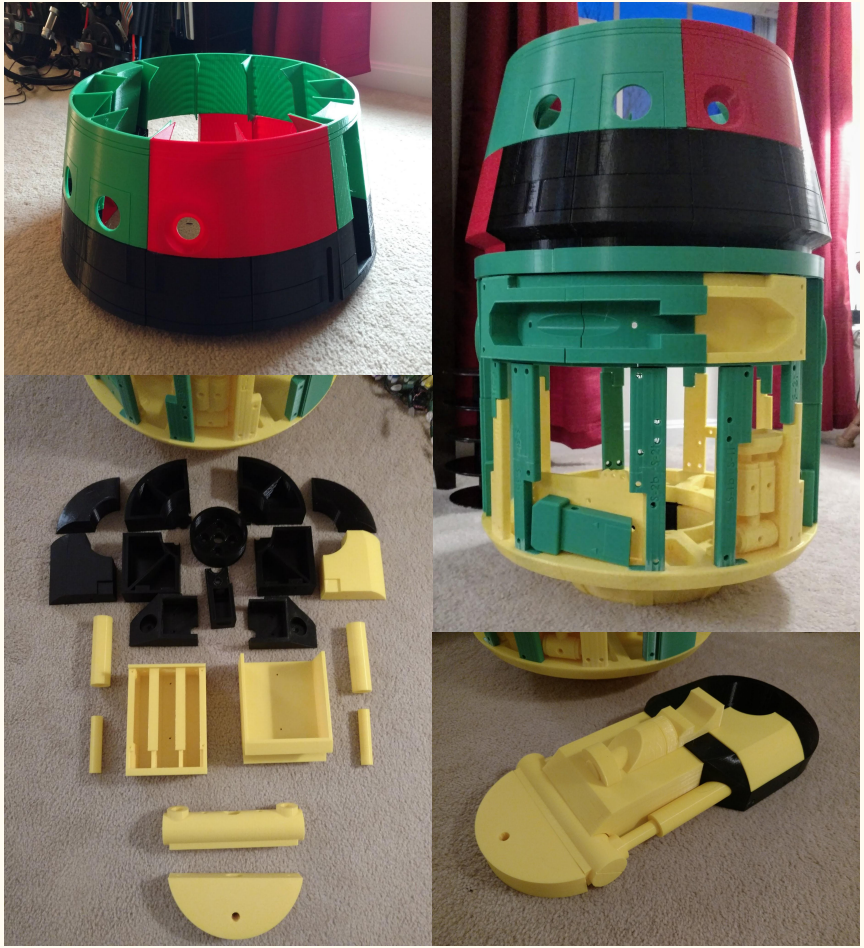




Starting the print process...

3D Printing

1. Started printing the dome mid December 2017. Quickly realized this was going to take a while.
    a. Made printer modifications for faster printing
2. Main body frame was done mid January
3. Legs were complete mid February
4. All structural parts done by March 1 2018



Finally Standing

1. After two and a half months chopper was together and standing.
2. I tried a new method of gluing PLA utilizing Weldon 3
    a. 3D Printing Pen also used to “weld” internal parts together
    b. Super Glue and Gorilla Glue also used in various places
3. In all 16 spools of Hatchbox PLA was used ($368)

Electrical Design

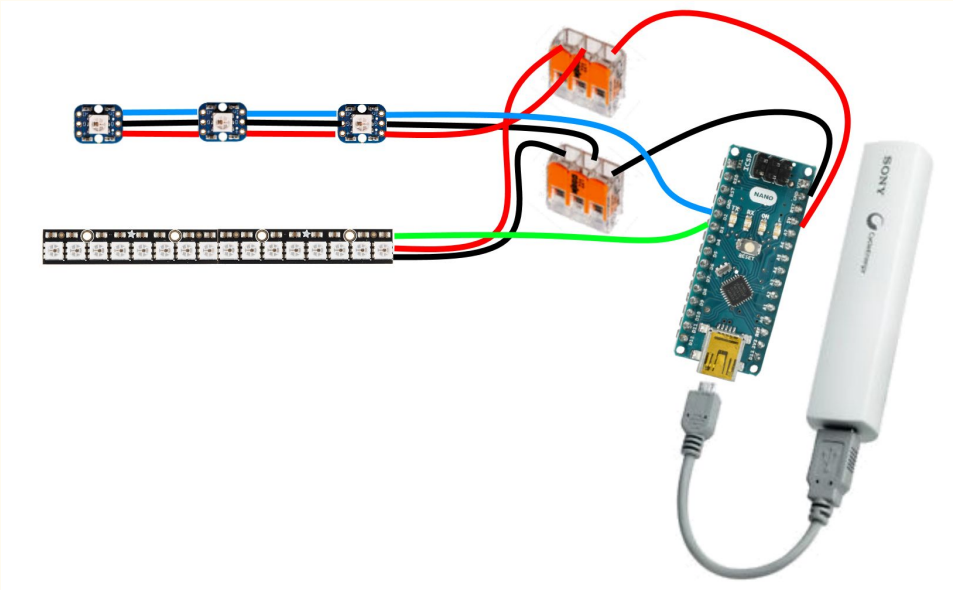
Electrical Design: Dome

1. First decision was to have the dome lighting automated so there is no connection between the dome/body

2. Only doing the lights for now.

3. 2 neopixel sticks for powercell animation. Individual neopixels for eyes

4. All powered by an arduino nano with a small usb phone charger.



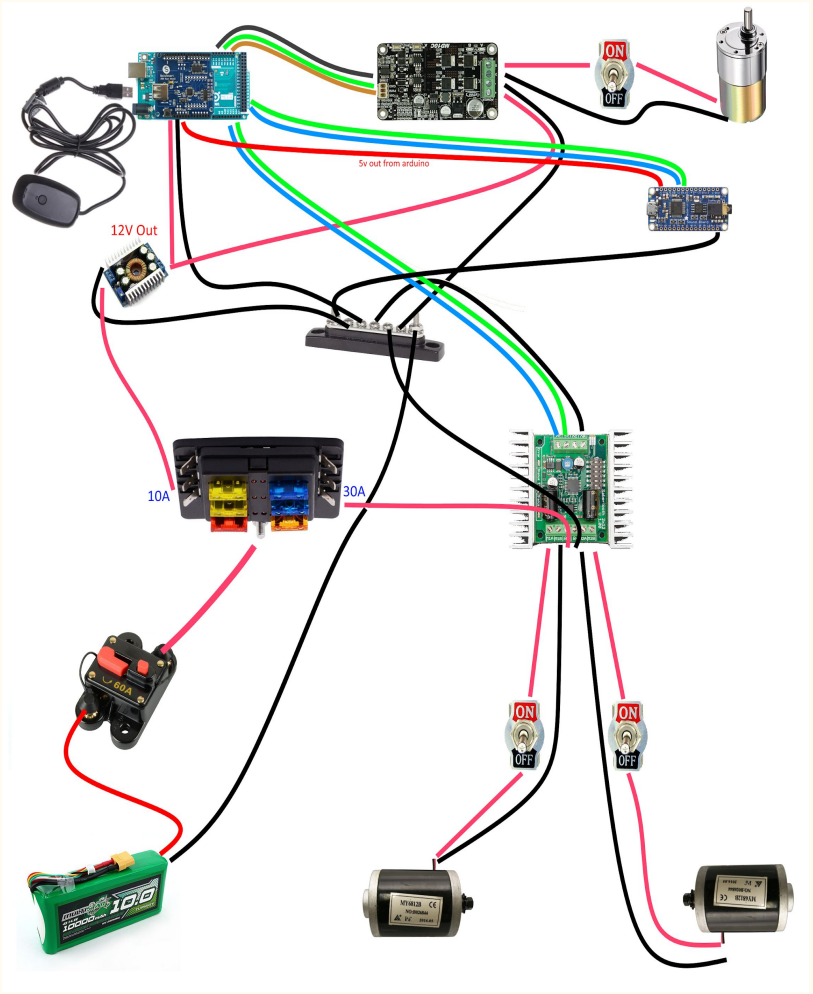
Code/Models Available: https://github.com/CountDeMonet/ArduinoChopperDomeLighting

Dome Animations

Demo Code

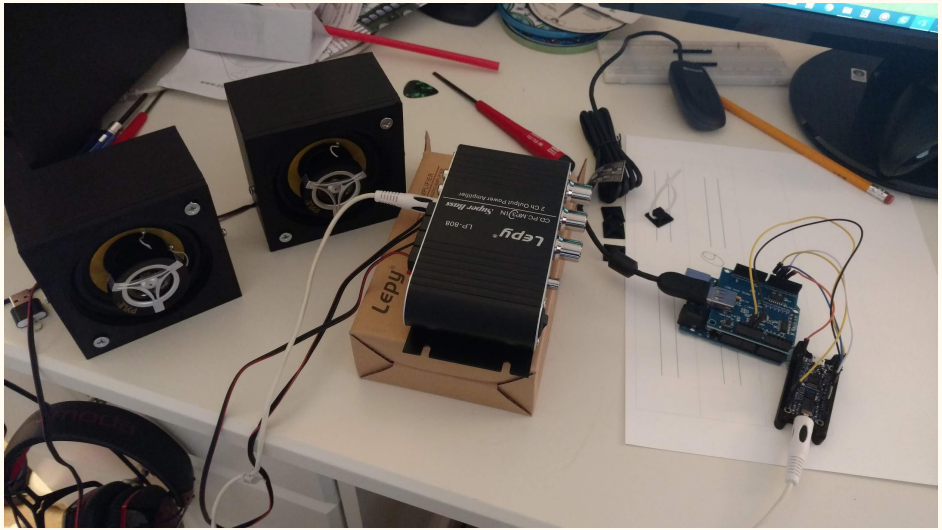
Electrical Design: Body

1. Brain: Arduino Mega with USB Shield controlled by Xbox 360 Controller
2. Dome Rotation: Cytron 10 amp motor controller for a Uxcell 12V 400RPM
3. Foot Drive: Sabertooth Dual 32A motor driver for two 24V, 100W motors
4. All powered by a single 4 cell 10Ah battery pack



Electrical Design: Audio

1. Adafruit AudioFX chip
2. Lepy 808 Mini Power HiFi Stereo Audio Amp
3. Pyle 3.5" Inch Speaker System - 120 Watt
4. Mpow Ground Loop Noise Isolator



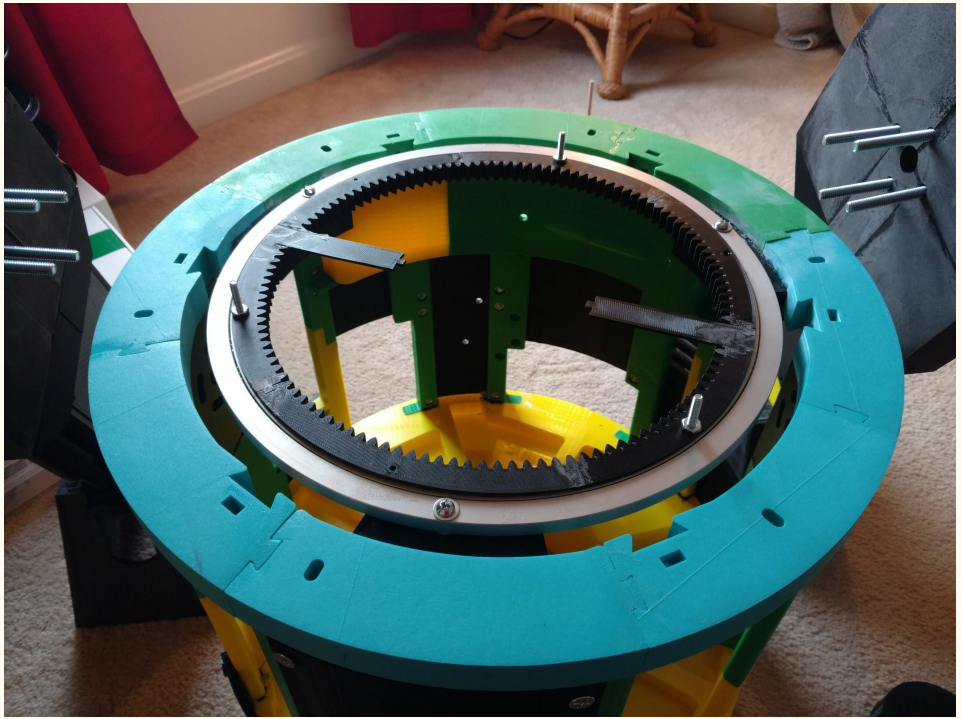
Body Code/Models Available: https://github.com/CountDeMonet/ArduinoAstromechControlSystem

Mechanical Design: Dome Rotation

Dome Rotation Gearing

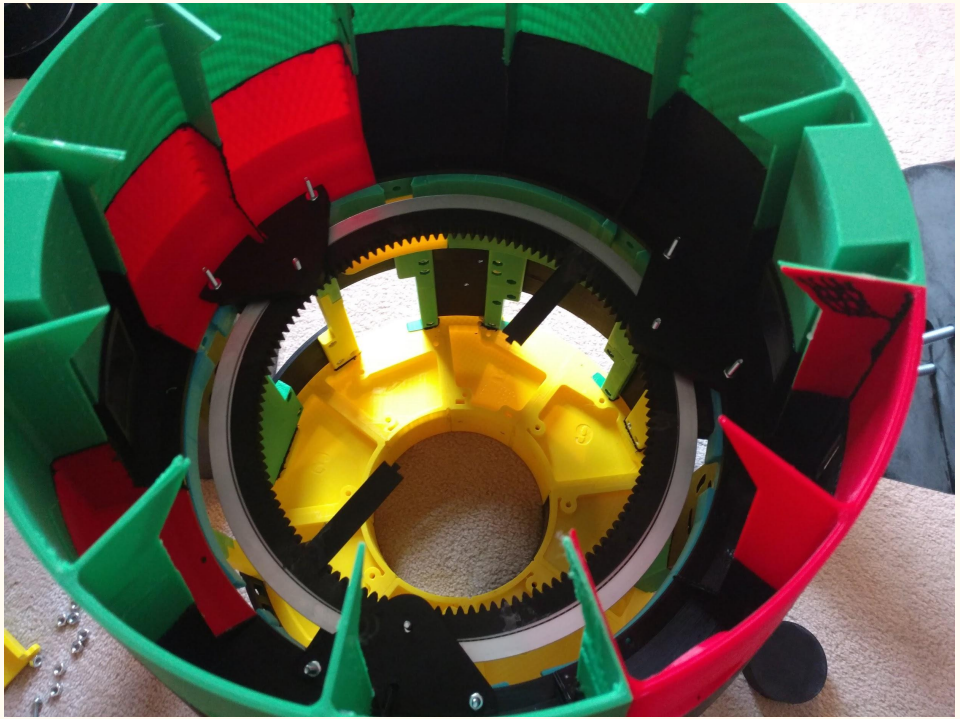
1. On the body sits a 14 inch lazy susan bearing that has been modified with a 3d printed gear

2. Drive motor is mounted to the frame and has a 3d printed gear mounted to it to spin the lazy susan



Dome Rotation Mount

The dome has 3 mounts screwed onto it. These mounts slide down over the protruding screws on the lazy susan and allow the dome to rotate.



Dome Rotation

Initial Testing

Mechanical Design: Center Foot

Center Wheel Failure

1. The caster mount for the body was designed but never used by the designer. It had a few issues
2. With the body laid back in 3 leg mode the caster would have no way to rotate.
3. I modified the design to have the proper angle in the wheel so the caster worked properly.
4. Unfortunately this proved to be too weak of a design for a 60 pound droid even when printed with high infill using PETG. The mount always broke at the same place.

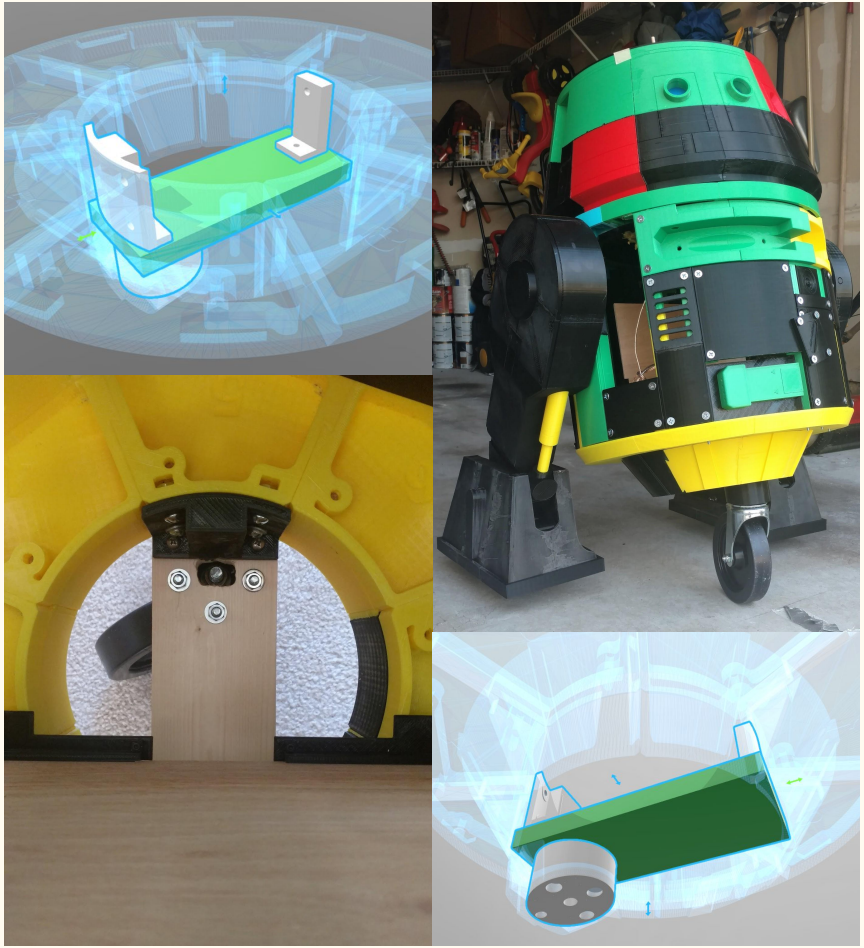
Center Wheel Take Two

1. The breaks were occurring when going over bumps so I had to design something that can handle the forces.

2. Based on the original mount I inserted a 1x4 between the skirt supported front and back.

3. A new front caster mount was designed to match the angle and screw into the wood using machine screws.

4. Available on Thingiverse: https://www.thingiverse.com/thing:2810836



Mechanical Design: Foot Drive

Drive System Source

1. The Razor E100 Electric scooters are very popular in the astromech building space.

2. I was able to source two of these scooters for $50.

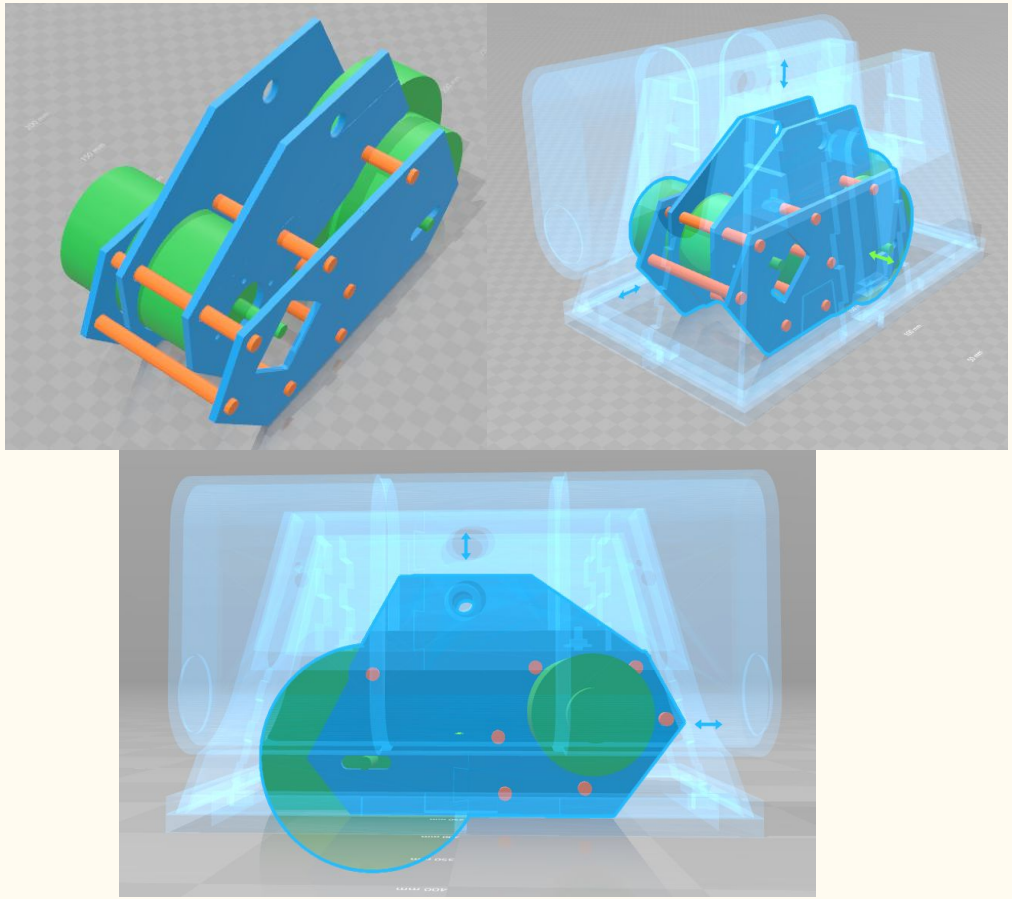
3. I pulled the drive system from both. Motors, chain, and 6 inch drive wheel

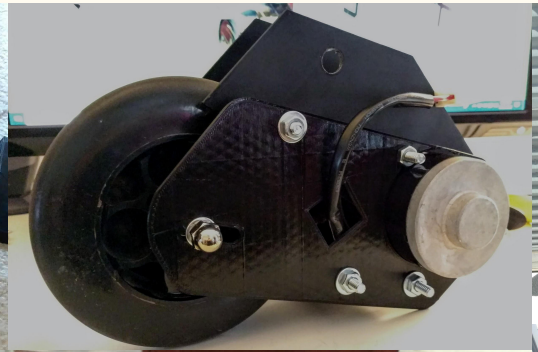
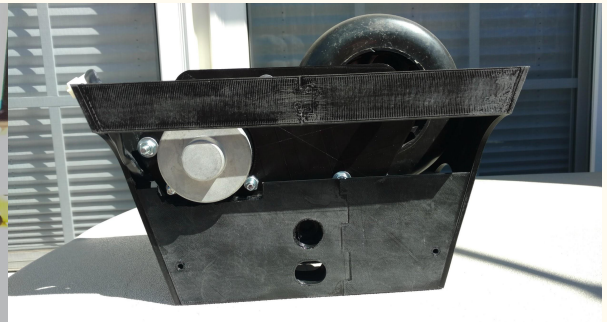
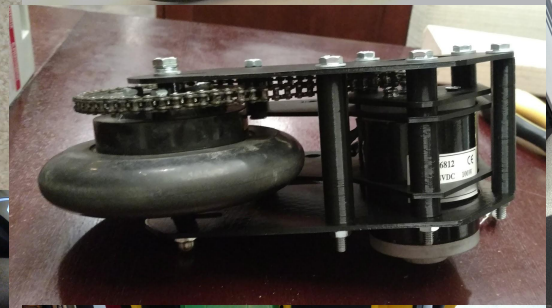
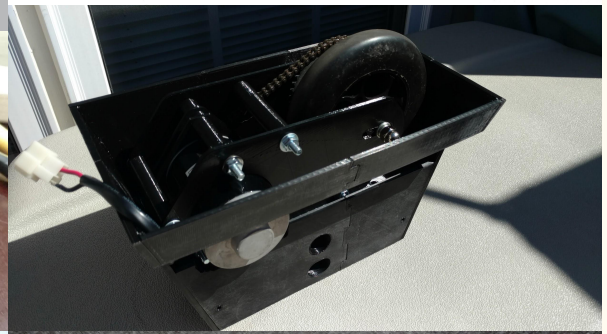
4. The rest of the electronics were useless so I scavenged what I could.

Drive System Mount

I decided to design a Flat Pack style motor mount. This consists of:

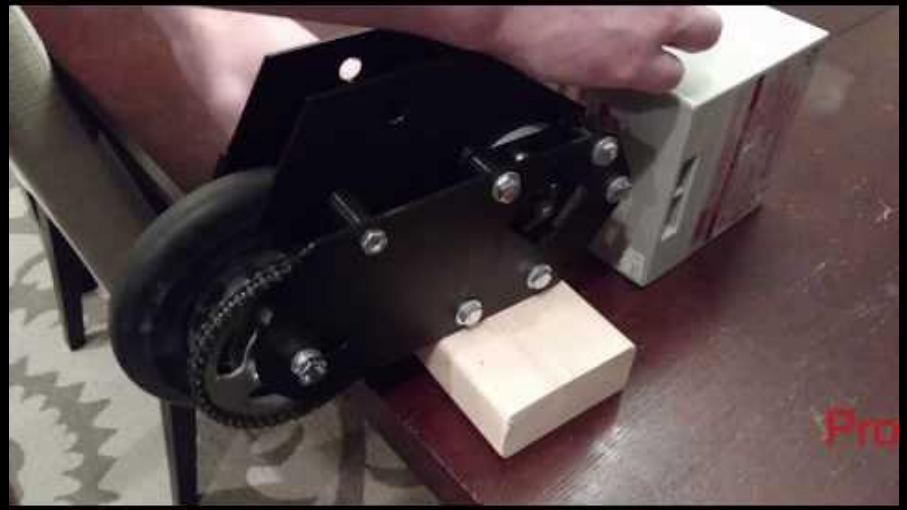
1. Two main outer frames for the wheel
2. Two inner frames for the ankle bolt mount
3. One motor mount
4. Lots and lots of screws/spacers




Foot Drive

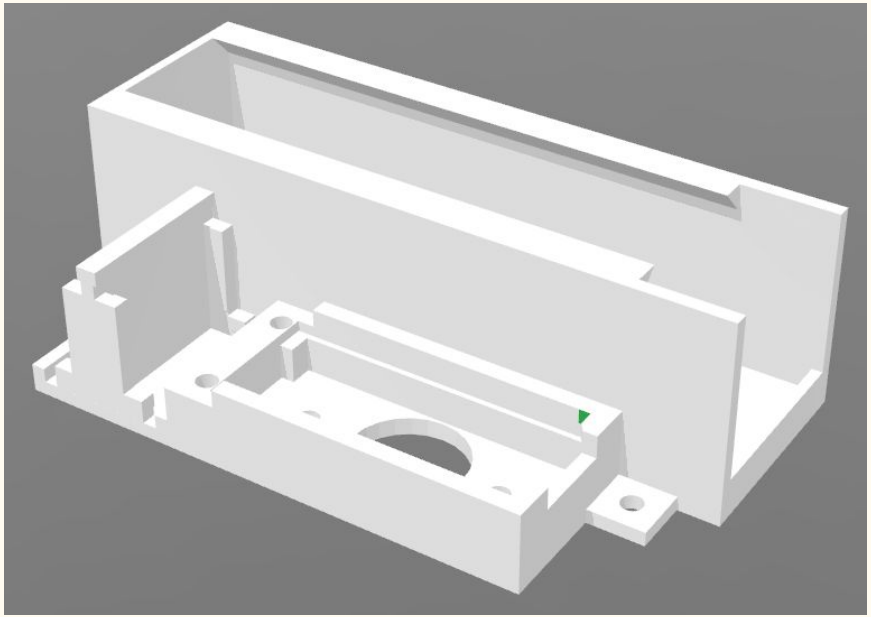
Design Test



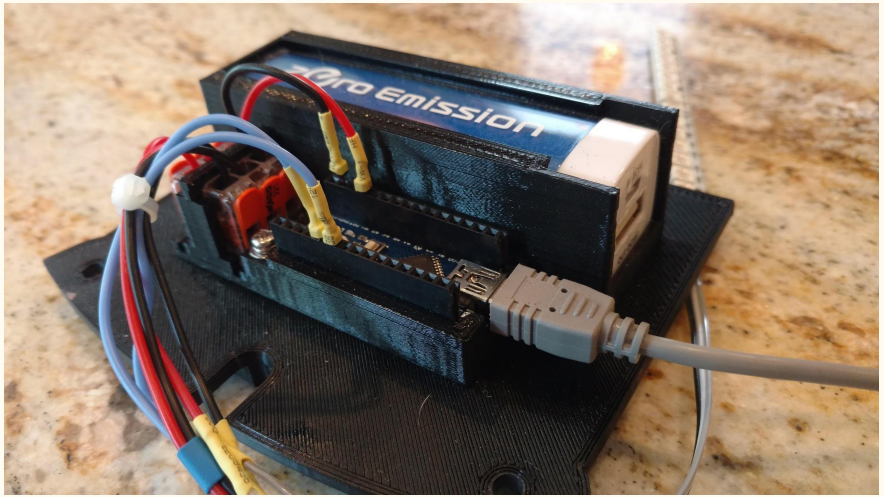
Putting it all together...

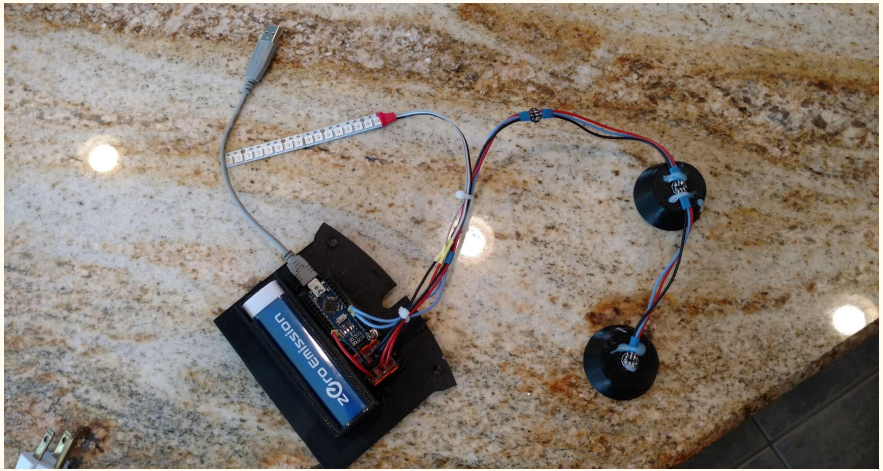
Dome Electronic Mount

- I wanted to make the package as neat as possible so I created a mount to hold the arduino, battery, and two wago 221 3 conductor lever nuts
- I also created a platform based off the lazy susan adapter that this mount can screw into.
- It came out very clean.



Dome electronics and wiring

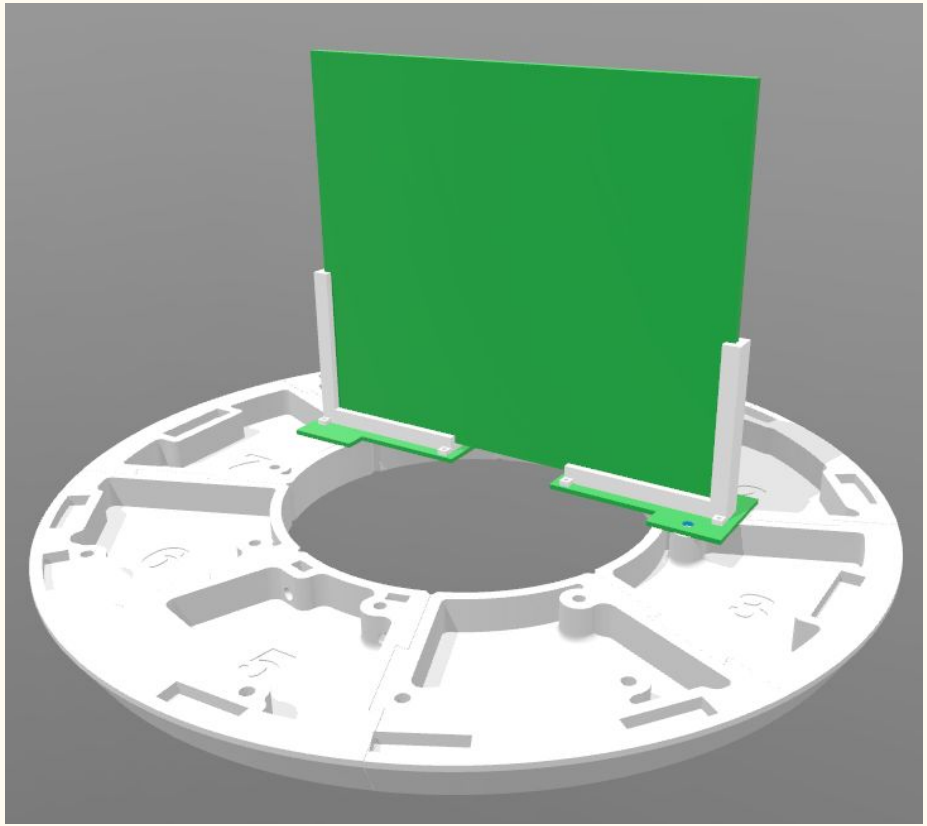


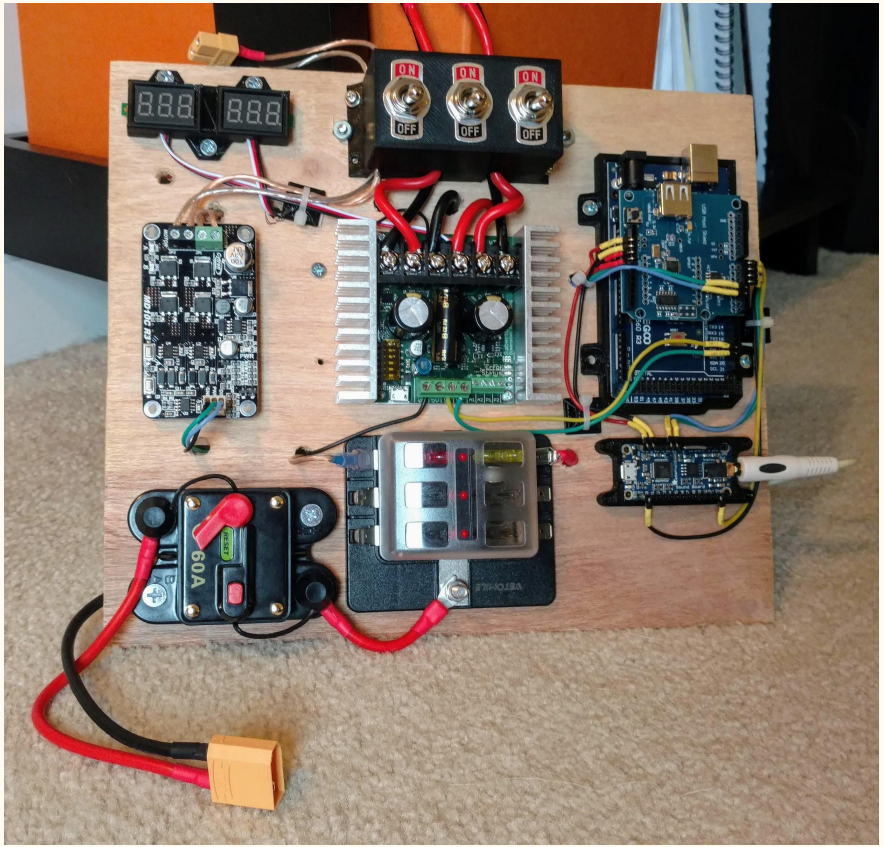


Main Electronic Mount

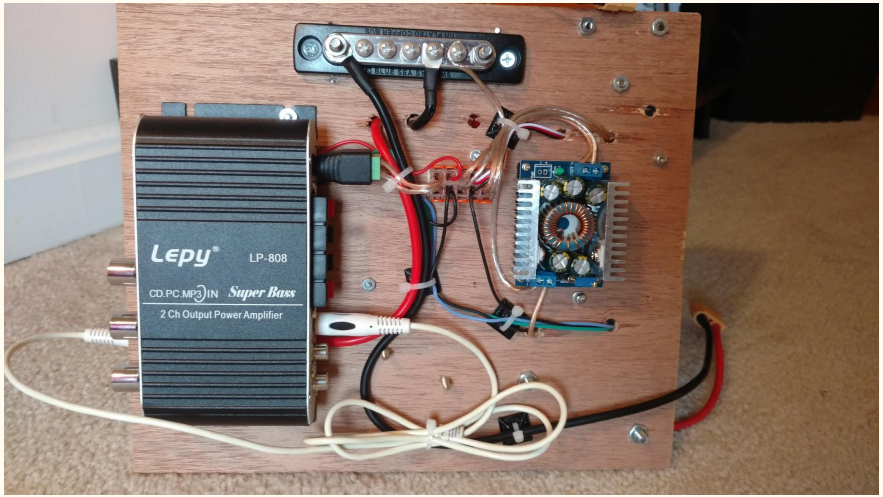
I had a few design goals for this.

- First I wanted it to be as clean as possible as I've seen other droids get out of hand fast.
- Second I want it to be easily serviceable for code updates and maintenance
- I decided that I would mount everything to a piece of plywood that can slide in vertically and lock in





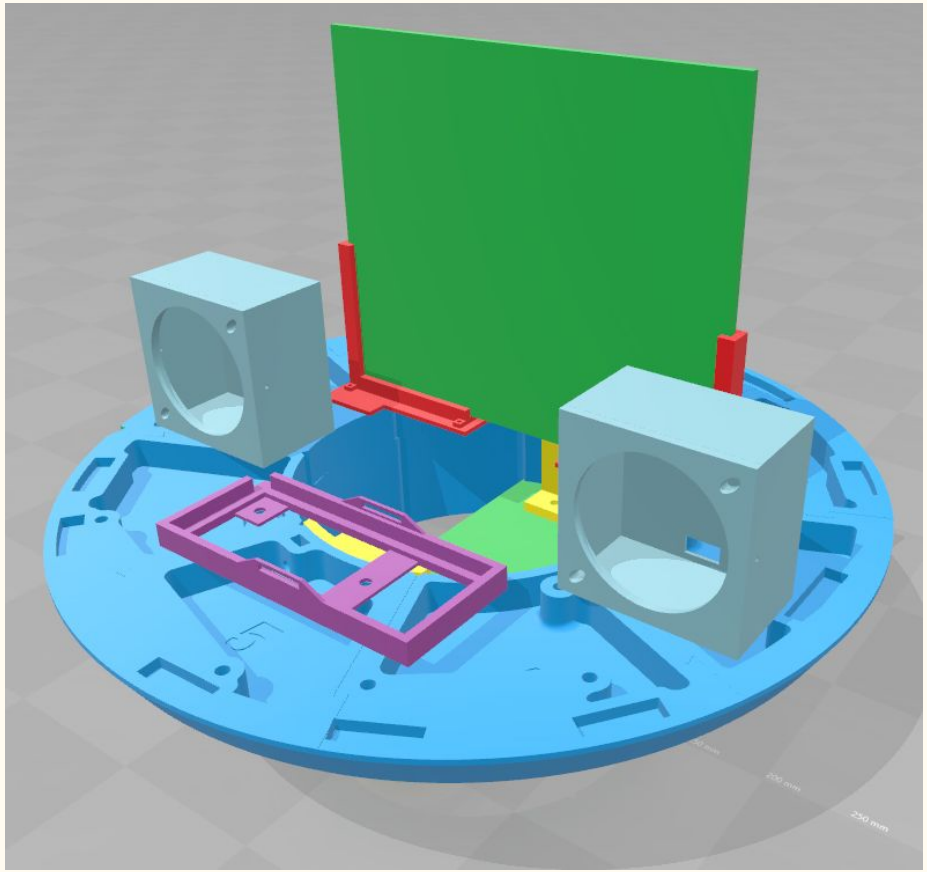
Literally a Circuit Board



Body Components

Now that the main parts are done I still have a few more things to mount.

- A battery holder was created and I chose to put it towards the front of the body.
- Speaker enclosures were designed and mounted on either side of the body.
- To keep with the serviceable goal everything is hot glued into place.
- Battery and electronics mounts use dowels into the base to help secure them

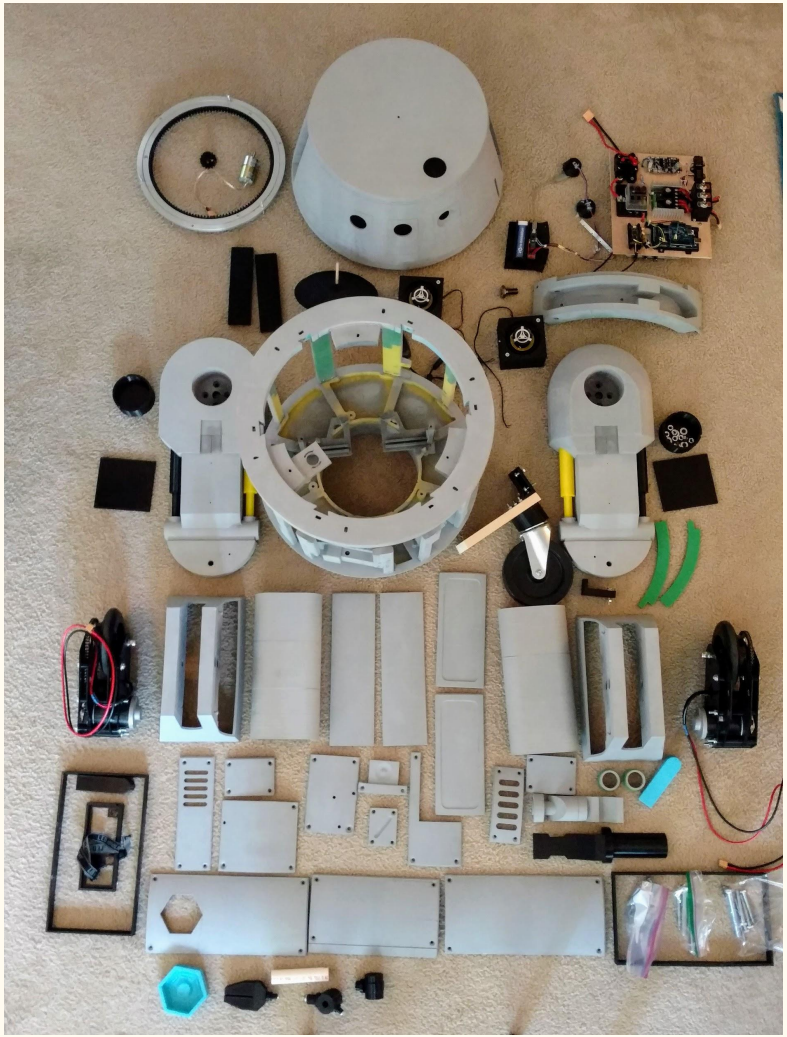


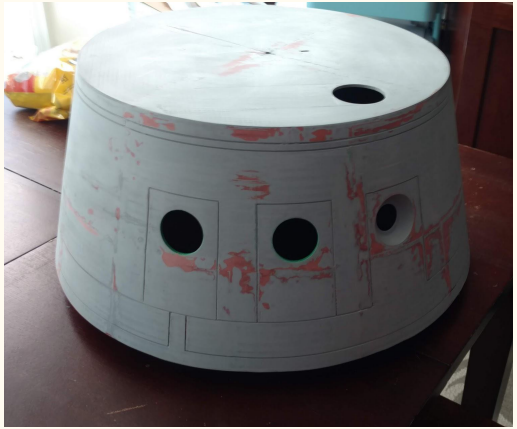
The Finishing Process...

Disassembly and Repair

Now that the design is done and validated it's time to prepare the body for paint.

- The first step is taking the robot completely apart.
- My finishing process involves:
  - Thin layer of Bondo Glazing Putty then sanded
  - Rustoleum Automotive Filler Primer is applied and sanded.
  - Repeat until all issues are addressed



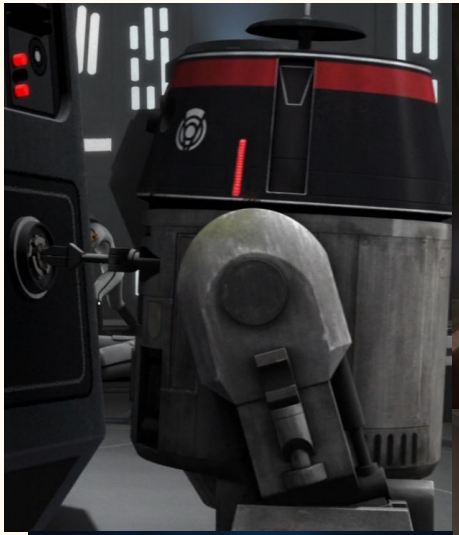


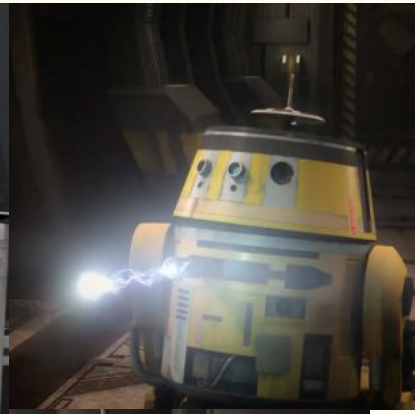
What’s next?

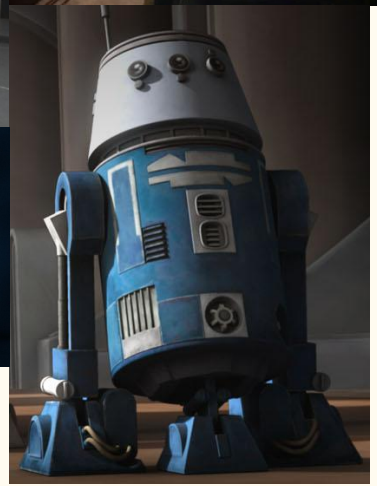
Painting and Naming

I still have a lot of finishing work to do on the body before paint.

- Decide on a name and paint scheme
- Chopper has had a few disguises in the Star Wars Rebels show.
- Lots of example paint schemes out there for R2 to take inspiration from







Add On Features

Once the core functionality is complete I hope to add on a few features.

- Better Dome Automation
  - I'm thinking about using a few hall effect sensors on the body with a magnet on the front of the dome to detect position
- Add a connection to the dome electronics so I can control the dome lights and possibly add in the retractable dome arms.
- Animate the front claw
- LED's around the body
- Implement retractable periscope

Thank you!