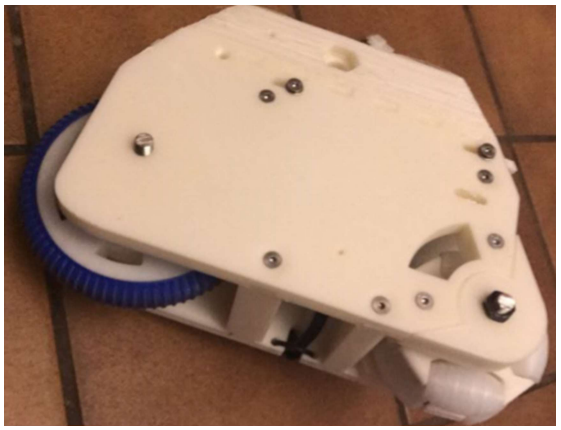
MrBaddeley
R2D2 version 2 Outer Foot & Drive instructions
Version 0.1 (Draft)

https://www.patreon.com/user?u=4294285
for other parts and instructions

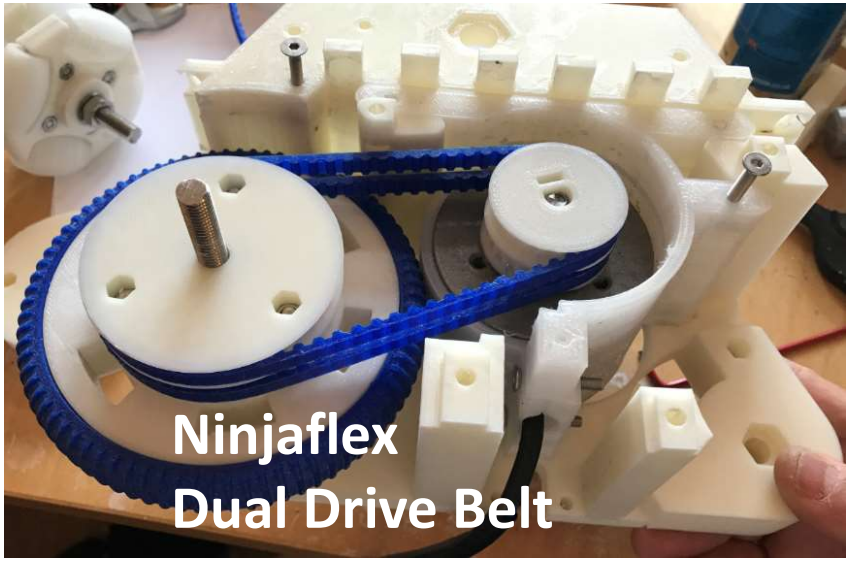
Features…



100% printed

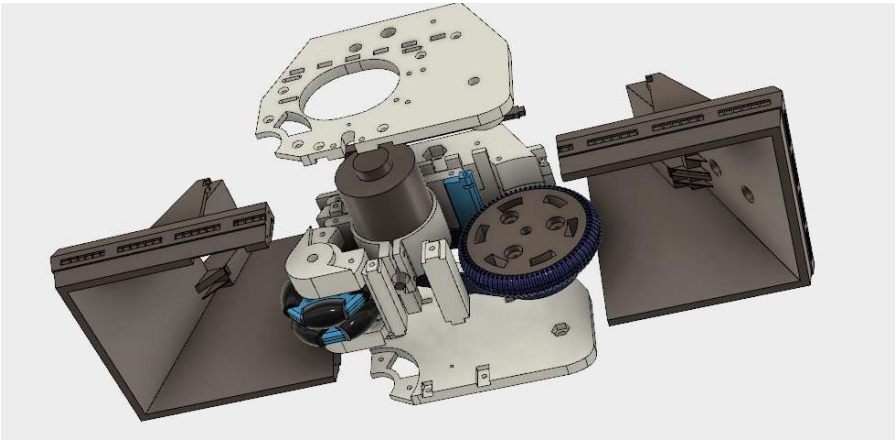
Printed Skins

Razor e100 Motor Compatible



Built in Omniwheel (Also Printed)

MrBaddeley R23D printed drive instructions



100% printed, no supports for the shells. All cable management, holes / bolts / nut recesses prepared.

Firstly the basics, the drive mechanism is printed in three different filament types. ABS for the main frame and skins. Ninjaflex for the tyre & drive belts and Nylon for the Omniwheel wheels.

All can be printed at .3 layer height. I would use at least 25% infill for the drive system, with 3 outer layers as this takes the most stress.

The drive system is modular. I've tested the ninjaflex drive (and have a number of iterations to get to this point). This hasn't been tested under full load but looks good so far. Will update as I test. It is modular so worse case we can go back to a standard toothed belt (non-printed) but I'm convinced it will work. The dual belt design does massively increase the torque and I can't stall the motor.

I used a e100 Razor motor (mine had the chain sprocket fixing). This was easy enough to remove with two pairs of plyers to remove the end nut. The new drive spocket just fits over the drive shaft and a captive nut hold in place.

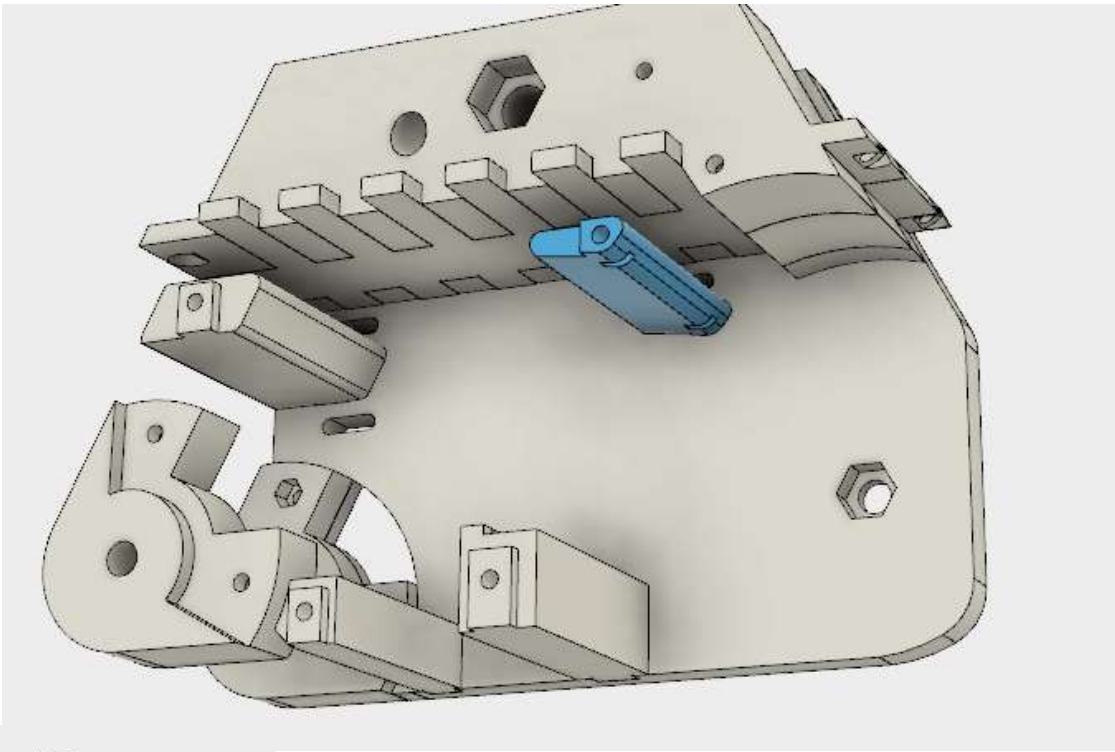
The print / build order is: Drive Frame, Omniwheels, Wheel and Drive gears and Drive belt. Finally the skins.

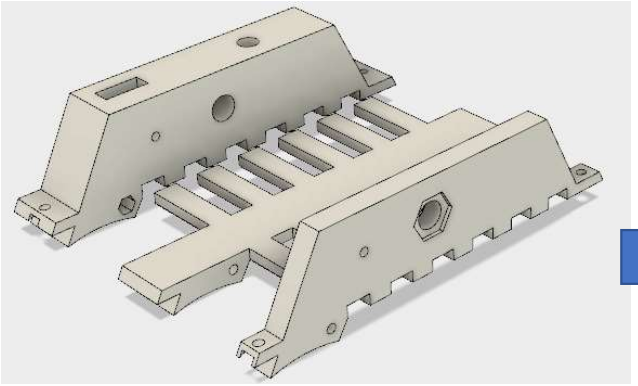
Drive Frame

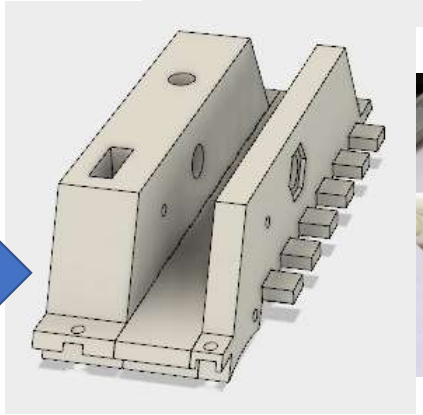
Building the frame: Print out all the frame parts, ABS is perfect for this, but I would increase the infill percentage to at least 25%, Anything past around 60% really doesn't add much strength so don't go much higher.

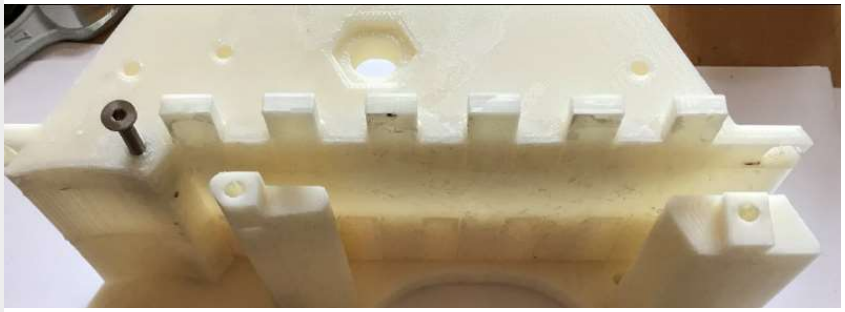
Print the two side frames, RearOmni parts, and the posts. Then print the Topframe parts.

Firstly assemble (glue) the top frame. For ABS I would recommend Acetone welding.



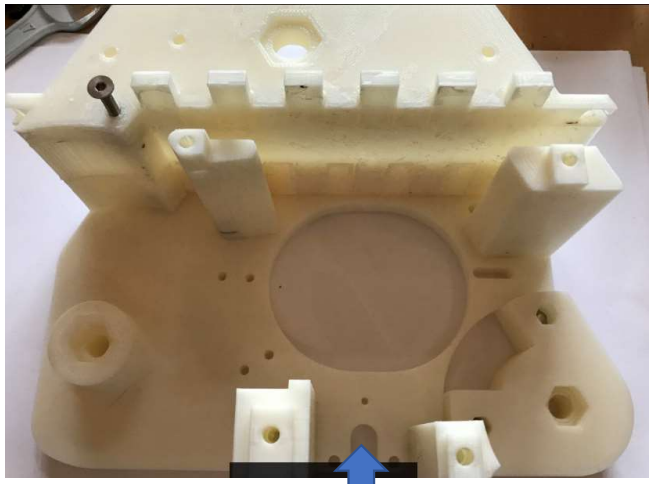




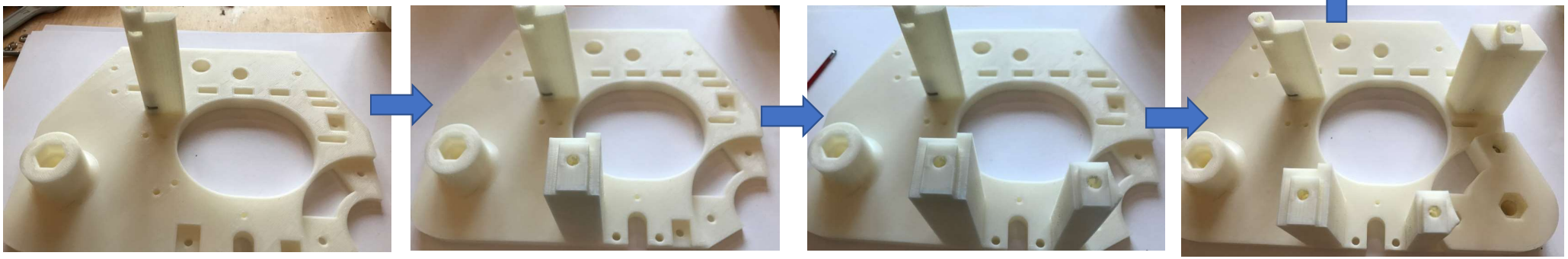


Building the frame pt2 : Take SideFrame A and bolt in each of the posts. This is using countersunk M4 bolts and square nuts. Length doesn't really matter too much (I got a variety pack of M4 nuts / bolts which I used to assemble.). Add the RearOmin Bracket and you should have the basic frame.

The push the topframe (previously assembled) into the square slots and attached using two M4 bolts and standard nuts. *Note to add captive 12mm nuts into the hole before adding the topframe, this is for the ankle joint when adding the legs.*



Note, tape may be useful to hold the nuts in place as it's frustrating as you tip the frame around and they fall out (from personal experience, grrrr).



Fixing the motor bracket.

Next print out the MotorBracket. The motor should fit perfectly into the frame with the cable slotting into the hole between the two securing bolts. Tighten up so the motor is extremely secure.

The frame again has slots for captive nuts (square M4 nuts), again fit and tape if necessary.

I initially printed this in Nylon but ABS is perfectly strong enough to hold the motor, Nylon is really overkill.

The Motor bracket should fit comfortably into the assembled frame.

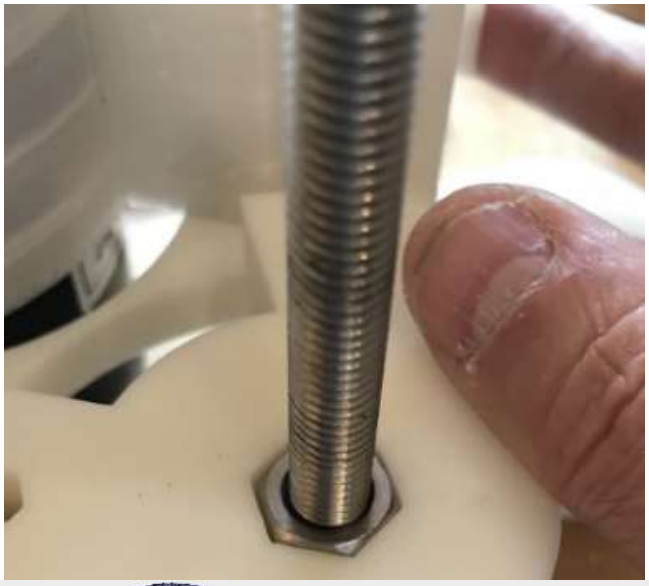
- **Building the Omniwheel:** The frame is printed in ABS and the wheels are printed in Nylon (I use Taulman Bridge Nylon, superb filament).

- Print all the parts (ABCD frame parts, 8 wheels in Nylon. You will need supports for the bearing holes and nut holes.

- Assembly is fairly easy. You will need 3mm Stainless rods, cut to length which is easily measured again the frames. (They should be 40mm or just a fraction under in length). You need 8 rods. Additionally you'll need 8mm bearings for the center. These just slot into the middle and should fit comfortably.

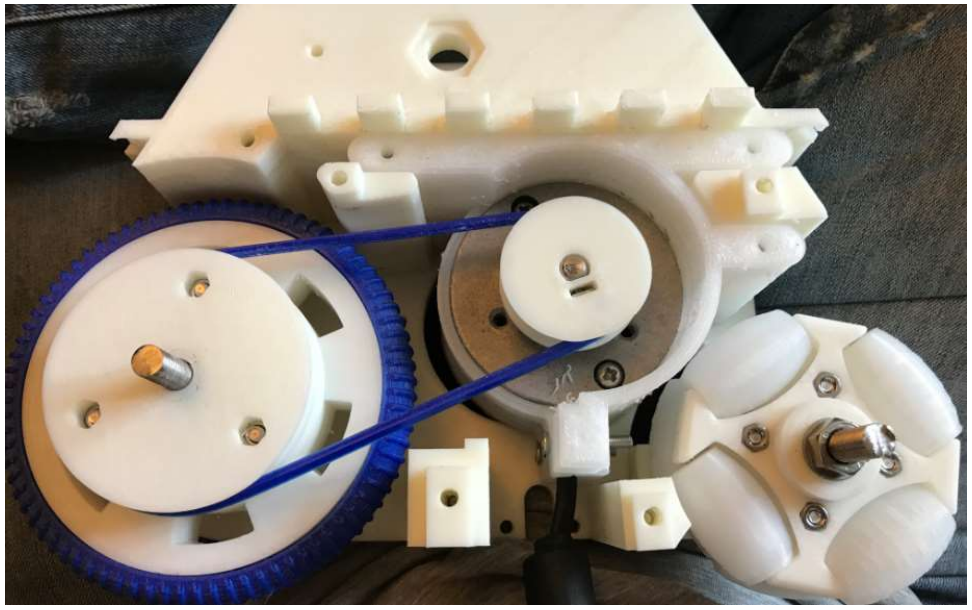
- Each pair of frames are held together with M4 Bolts (10mm I think) and M4 Standard nuts. I used hex bolts which fitted perfectly.

- Assembly the two Omniwheels, they fit together with lugs / holes. If fitted correctly the wheels are 90 degrees to each other like the diagram. The don't bolt or screw together, as long as they fit together all is good!



Print out the Motordrivewheel, the Drivewheel and the wheel in ABS (again I'd suggest at least 25% infill).
Print out the tyre and two drivebelts in Ninjaflex. For the drive belts I printed 4 perimeters with no infill, infill does give an inconsistency on the drive belt and can cause many issues.
For the tyre I printed 20% infill and 4 perimeters, this gave a solid but flexible tyre.
Then, stretch the tyre onto the wheel (should fit snugly). If you want to be extra careful you can gorilla gel glue the tyre onto the wheel (I didn't)!
Again, a 8mm bearing (two) fits into both the wheel and the drivewheel with the centre spindle in between. Again, M4 bolts and nuts hold this together to make a single assembly.

Putting it together.



Notes on the drive belts.

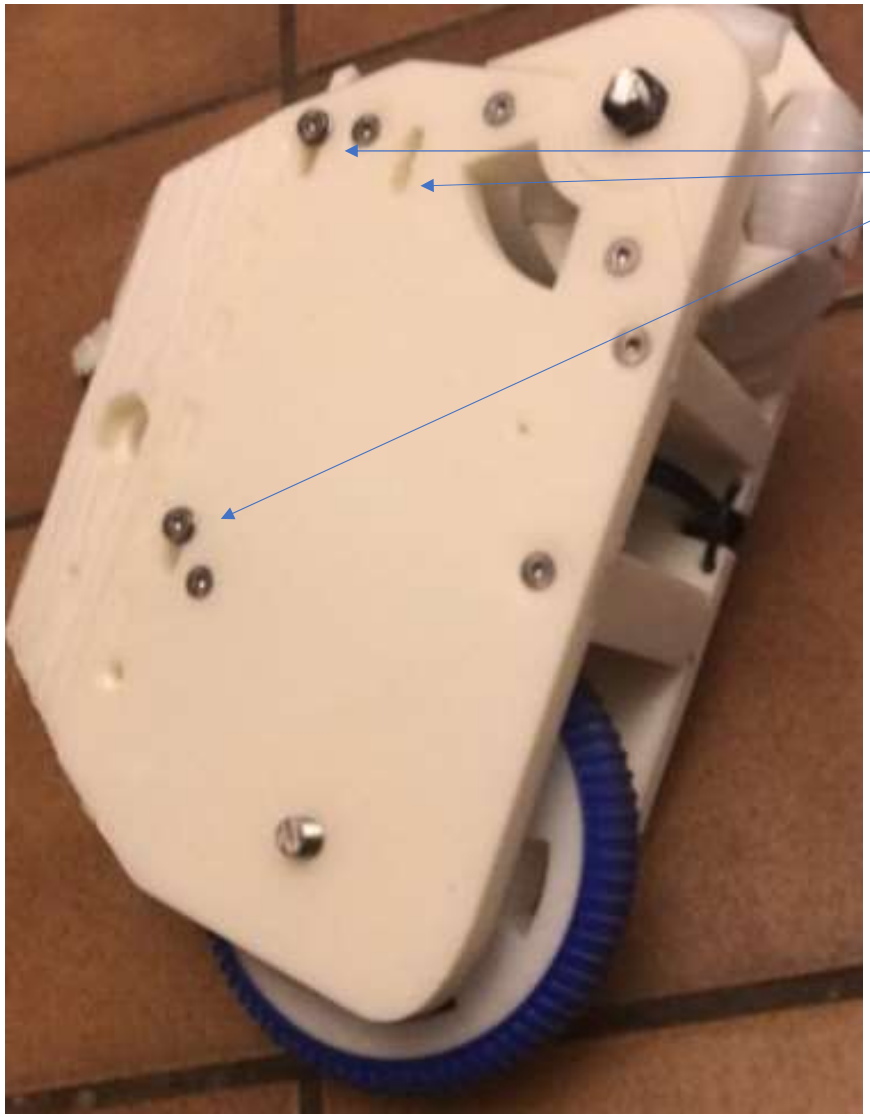
These are printed in NinjaFlex. No infil, but 5 layers at least on the sides and 2 top and bottom. I printed the belts at 97% size to give a bit of extra tension and this seems to work extremely well. Don't over tension these, they should be nearly at the loosest point. If you over tension you affect the gaps on the teeth leading to the belt slipping off. This belt drive may see further revisions once I've tested in situ.

Next step is to assemble!

Take some 8mm Threaded Rod for the two axles. 8mm nuts fit into the frame, screw the rods in and tighten another nut on the other side.

Add washers for both the wheel and omniwheel as appropriate (they shouldn't be too much play but move freely.

The Motor frame can be fitted next (with square nuts slotted in beforehand), note that the square nuts in the posts will need to be added before the frame is positioned. Small pieces of tape can be added to hold the square nuts in position or a drop of acetone ABS sludge. It is possible to assemble without anything holding the square nuts but extremely frustrating when they fall out. The two drive belts are fitted with no tension at the moment so the motor frame touches the wheel. The top plate then is slotted on and the remaining nuts tightened.



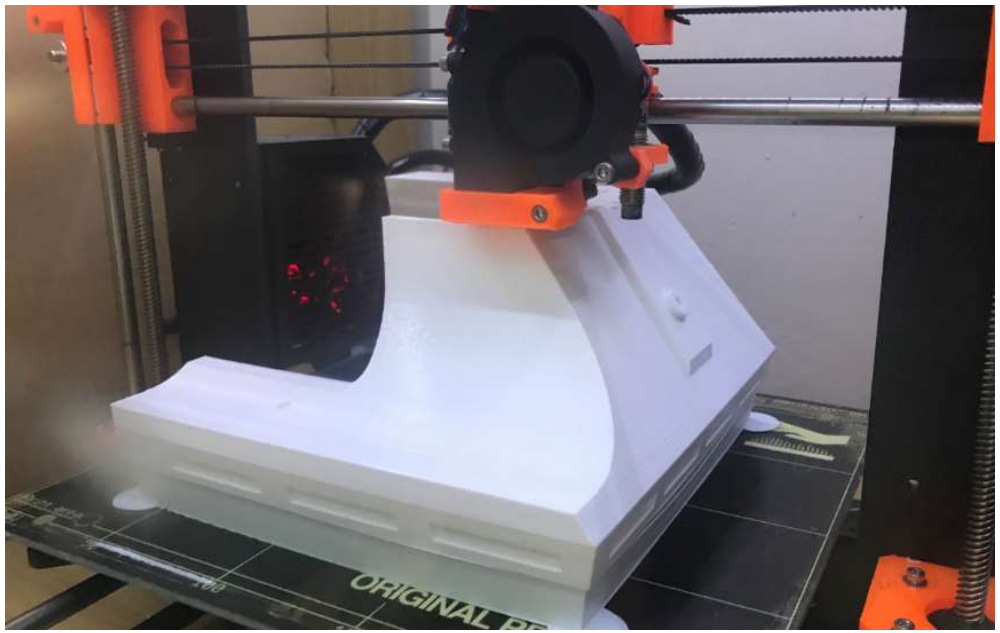
Final adjustment / finishing.

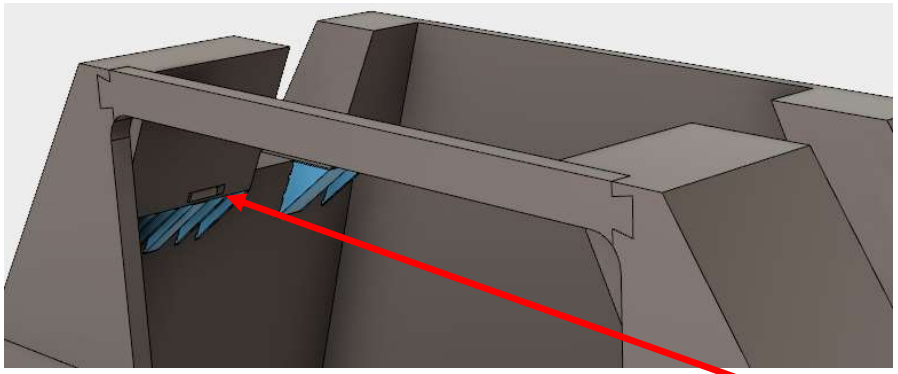
Use 6 M4 countersunk bolts to hold the motor bracket in place in the slotted holes. On the motor side, you can add washers but on the non motor side repeat. Note, the bolts stand proud of the plastic with the washers on them. This stops the shell from going on perfectly. I will modify the shell STL to include some recesses however you can do this with a Dremel if you print before I modify.

Move the motor bracket slightly off the loosest position to give a little tension, tighten the nuts and test everything moves freely.

The cable can then be cable tied up the motor side where the two adjacent cable tie holes are.

This pretty much completes the drive mechanism build.



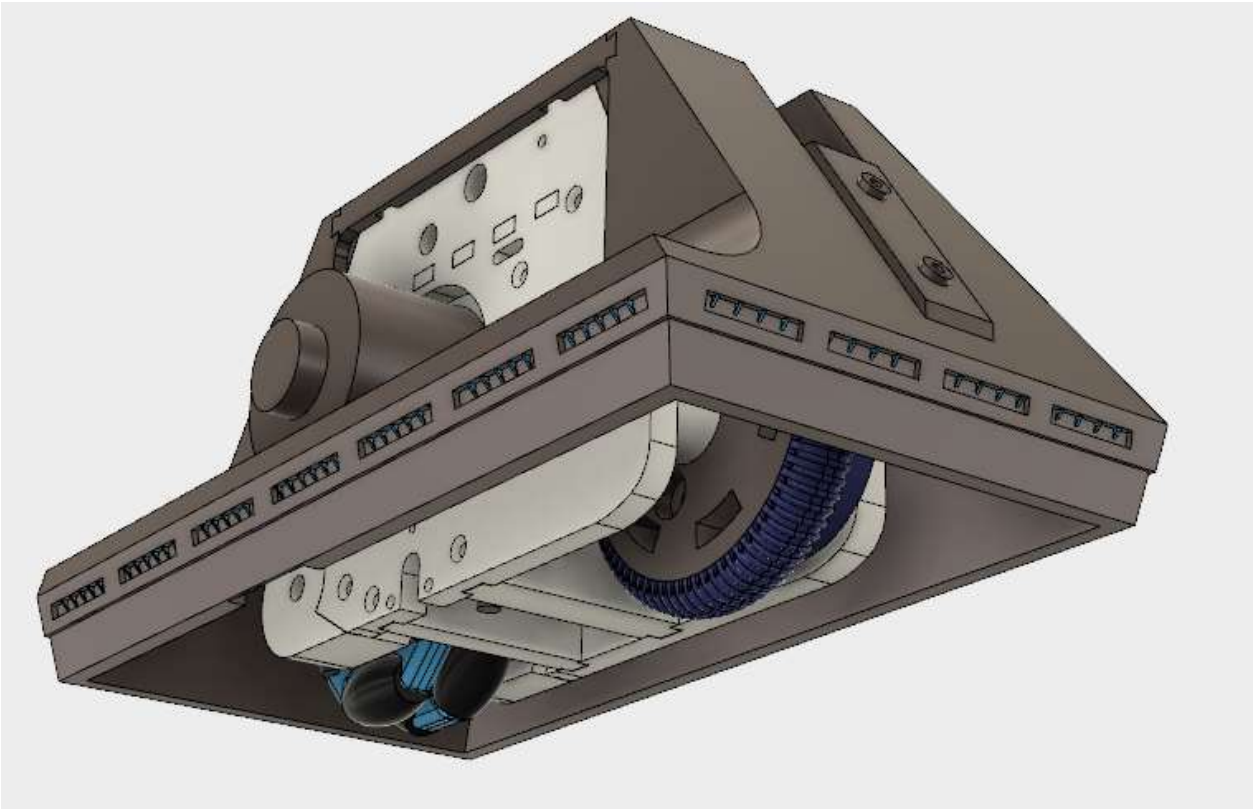


The shells.
I've included two version of the shells, one for anyone with a biggg print bed, where the shell prints in one piece. The other is for a 200x200 bed where it's printed in two parts. I have added all the supports into the design, so print without supports. I would recommend ABS for the foot shells and strongly recommend using helper discs on each corner, this is a big print and will be prone to warping unless you use helper discs and a good enclosure.

Low wall thickness and low infill will also help with the warping (I used 10% infill).
Print all the parts, the shells have a bar which need to be glued in at the top once fully printed.

I've included 1.75mm holes for filament pegs to hold / align when gluing the two shells together.

Remove all the supports and add the captive 4mm square nuts to each hole in the four corners of the shell



Finishing off

The drive should then slot into the frame (assuming the supports are removed and check if you need to Dremel some space for the motorframe screws on the opposite side of the motor).

Four M4 nuts should then be fitted at each corner to hold the shell in place.

Note also the cable hole just above the battery, this is where the leg cable with come from the body to attach to the motor cables in the battery box (to be released soon). The foot is held on the leg with 12mm threaded rod, which cut to length should screw into the captive nut previous fitted into the frame.

You've completed the foot drive!

Supported and tested by Rob Dinniwell, Joseph Masci, Gregory Welch, Sam D. Fenimore, LarryJ, tevans, Rick Davis, Brendan Faulkner, Nicolas Carré, Ben Langley, Mathieu Saint-marc, Chistopher Edwards, Mark Oram, Tim Parr, Jon Haag, John Gardener, Ryan Roehitch, Oiva Ranta, Wes Thierry, Robert Bean, Mitchell Young, Jake Danible, Simon Ruel, William Meyer and Brian.