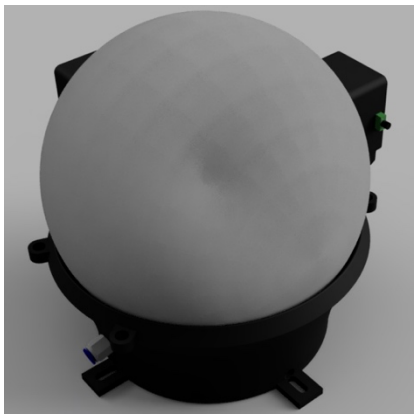
Spherical treadmill

Assembly instructions



This project is modified from a design by the Technocenter, Radboud University[1]. A 3D-printed base distributes compressed air evenly to support a floating styrofoam ball. Two sensors measure the ball's rotation speed on 2 axes. Typically used with virtual reality setups for mouse behavior.

BOM

- 3D-printed components
- 1x valve for standard air tubing with 6mm outer diameter. The actual part used is the MSCNL6-1 (selectable on https://uk.misumi-ec.com/vona2/detail/110300335060/)
- 2x Logitech G502 computer mice
- 4x M4 10mm threaded nuts
- 4x M3 8 mm screws and 4x M4 12 mm screws, 6-8 washers
- (optional) 4x neodymium magnets 5 x 2.5 x 1.5 mm (Length x Width x Height)
- (optional) for magnets, plastic compatible superglue (e.g. Loctite Super glue all plastics)
- 20 cm diameter Styrofoam ball (preferably in 1 solid piece, see e.g. www.grahamsweet.com. Note that true 200 mm diameter is not trivial to find, as most people use these for arts & crafts where precise dimensions are less important)

Tools

Thread tapping kit (including M3, M4, M10)
Set of small screwdrivers

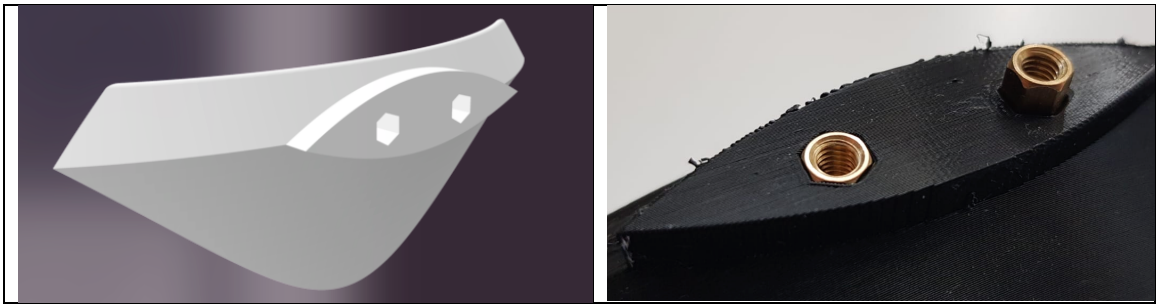
[1] A formal publication on the EU/CERN Zenodo.org repository to follow shortly.

STEPS

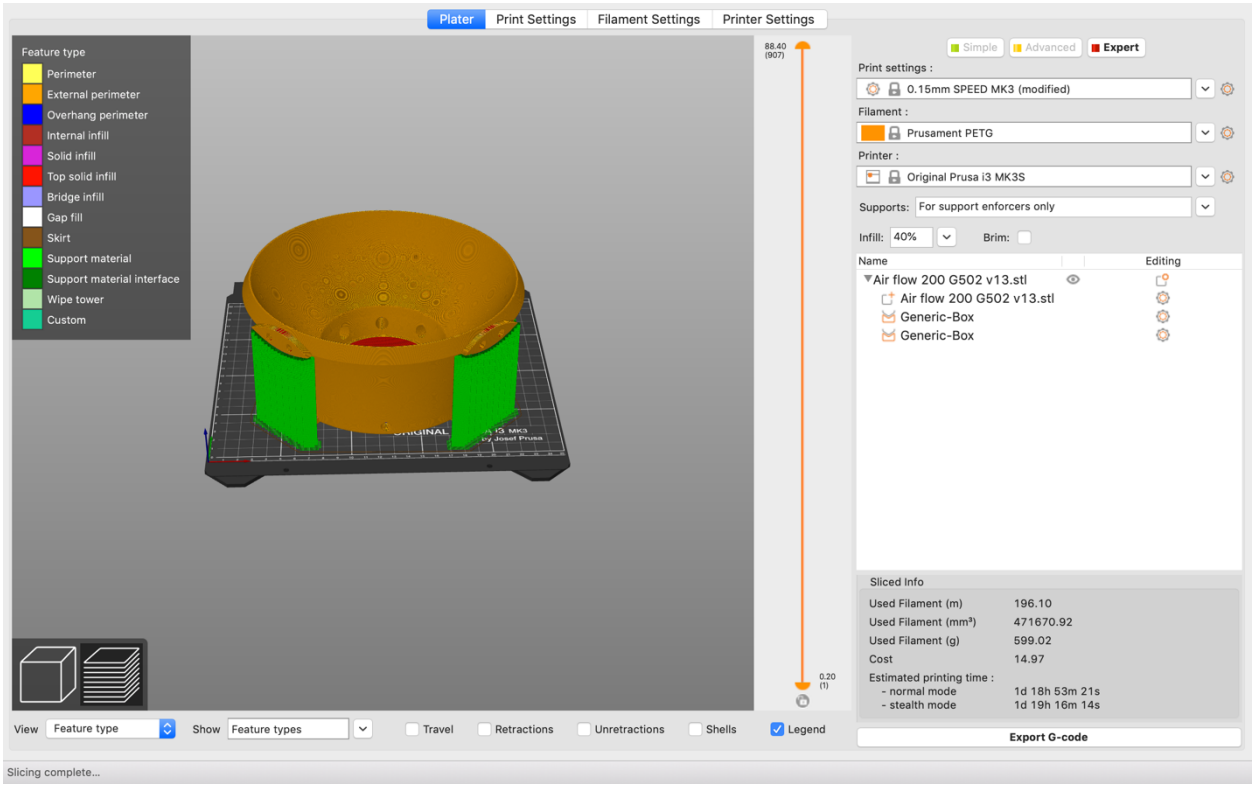
Printing the parts

We use black PETG filament (Prusament Jet Black on a Prusa MK3S), because these parts need to be strong and durable in the potentially hostile lab environment.

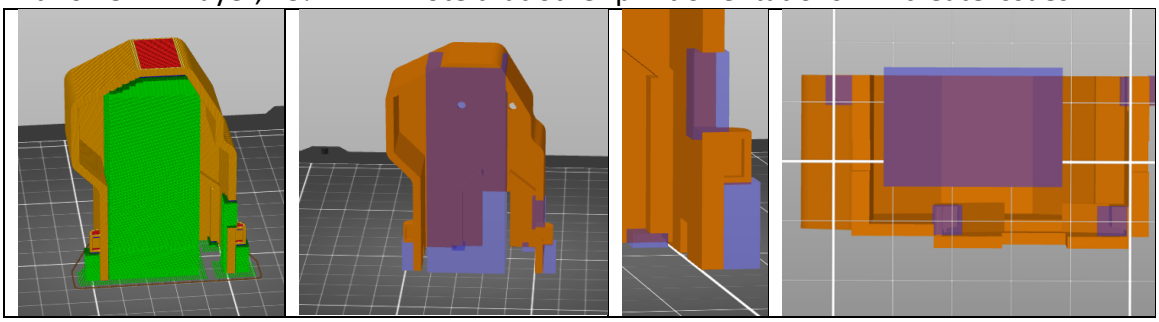
1. First, print a small section of the ball (`Base section for fit test.stl`), to test the fit with the M4 10 mm threaded nuts.



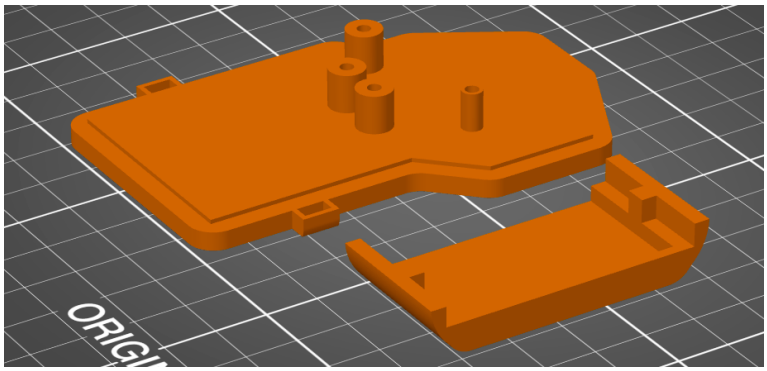
2. For the base (`Base 200 mm.stl`). If you print it yourself: it's a long print, and requires a lot of filament (600 g with 40% infill) so consider starting a new roll. Some supports are needed.



3. The sensor box (`G502 housing case.stl`) also requires multiple supports. Printed with 0.15 mm layer, 15% infill. Note that other print orientations will create issues.



4. The lid (`G502 housing Lid.stl`) and top (`G502 Housing top.stl`) do not require supports.



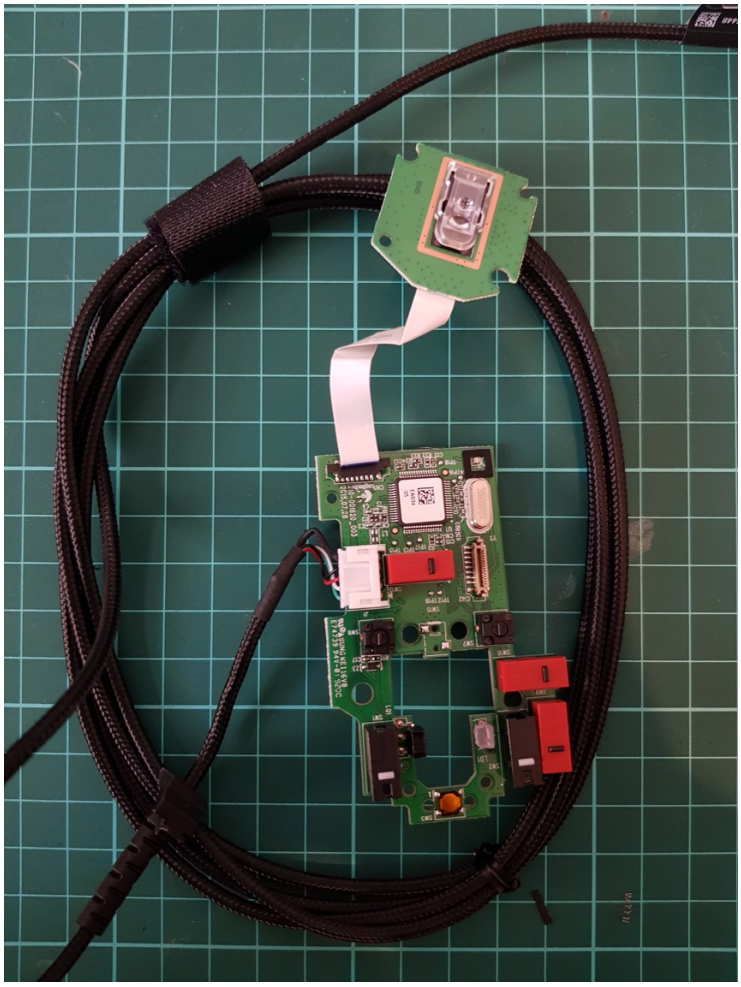
Preparing the optical sensors (2X)

Here we strip bare the optical sensor with board and USB cable. A set of small screwdrivers is needed.

1. Remove the bottom lid
2. Remove stickers (some have 2 layers) on the bottom. You should see 4 screws.
3. Unscrew those 4 screws.
4. Separate top and bottom encasing: first create some space using a small phillips head and leverage, then a bit of force.
5. Orient the mouse with cable at top. Set aside the left mouse click board (stands vertical near the magnet).
6. Remove the small black plastic pin on the wheel by pulling it to the left. Pliers might be useful for this step.
7. Remove the wheel vertically.
8. Unscrew the 2 screws of the wheel's support.
9. Detach left mouse click board cable from the main board. We won't need it.
10. Unscrew the 2 top and 1 bottom right screws.

11. Gently pull the main board and flip it aside so that you can see the sensor board.
12. Set free the cable, then unscrew the sensor board.
13. Test that the computer mouse still works by connecting it to a computer.

End result:



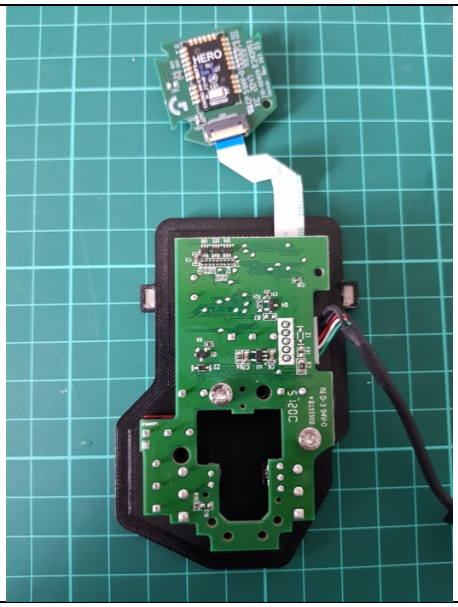
Preparing the base

1. Tap an M10 thread in the air input hole. Screw in the valve.
2. Push in the M4 10mm nuts. If it's a tight fit, no glue will be needed.

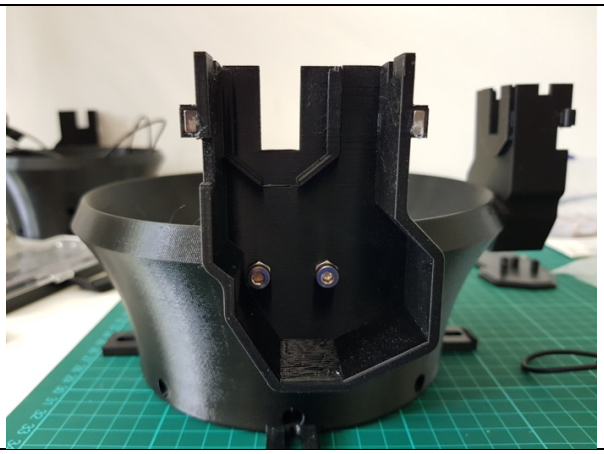
Preparing the optical sensor box (2X)

1. Box: Tap the 2 holes with M4 threads.
2. Lid: Tap the 3 extruding cylinders with M3 threads.

3. (optional) Glue the magnets. Because you are working with super glue, and the magnets are both strong and small, it's better to put the magnet on a metal rod (e.g. 2.5 mm allen key) for placement and glueing. Let it dry 10 min.
4. Screw the main board to the lid with 2 M3 x 8 mm screws.



5. Screw the sensor box to the base with 2 M4 x 12 mm screws. Use washers between the box and the base to set the distance between sensor and ball for optimal reading. HOW MANY?



6. Carefully slide the sensor into its housing while holding the lid so that the cable doesn't get overextended. It's OK if the sensor comes out a bit due to the cable tension. Immediately after, align the lid so that the magnets connect.
7. Put the top on. It will push the sensor into position.
8. Test with your 20 cm diameter ball the distance between ball surface and sensor.
9. Test that the computer mice still work.