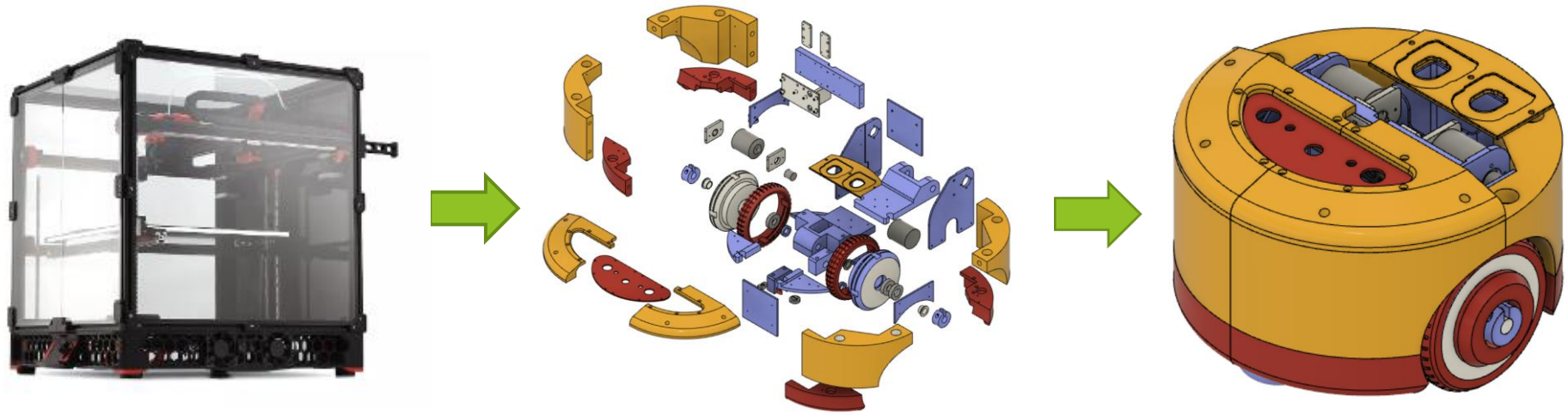
DIY 3D Printer and 3D Printed Robot

HP Tuners 2022
Personal Project

Project Goals



- Get into 3d printing / build my first 3D printer and learn about 3d printing technology, printer designs and related software / firmware / tools
- Learn how to design simple parts / objects using Fusion 360
- Print / build mobile robot platform (base of the robot with two-wheel drive system) for learning and experimenting with robotics next year

Printer – Design Selection and General Preparation

- Design selection

  VORON Trident printer design: open source, excellent documentation, parts broadly accessible, extensible, enclosure, build volume 300x300x250, high speed (max 300mm/s) – mainly limited by filament type and hotend characteristics. Based on CoreXY motion system with a fixed gantry and the 3-point bed moving along the Z axis.

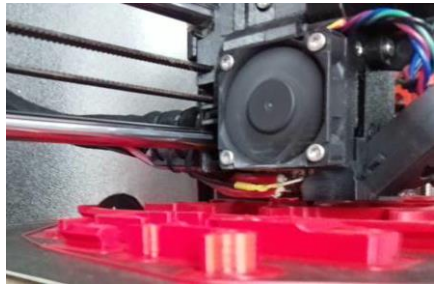
- Parts sourcing:
  - Formbot Kit
  - Amazon

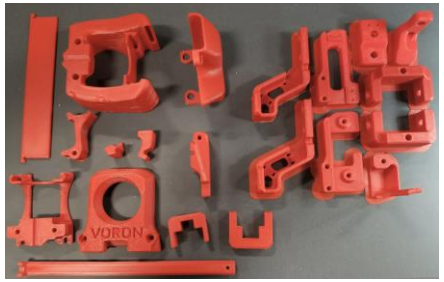
- Learning 3D printing basics:
  - Printer setup / usage – using HPT Prusa printer
  - Slicer programs, print / filament / printer setting and slicing tips

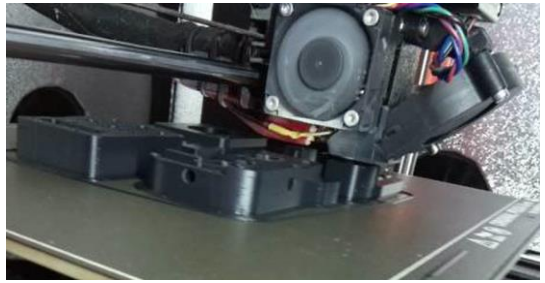
Printer Build Plan and Preparation

Plan

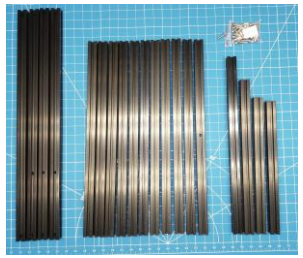
- Print essential parts on HPT printer
- Build basic printer (no panels, skirts, final fans and electronics holders) and use it to finish parts printing
- Finish printer assembly and fine-tune

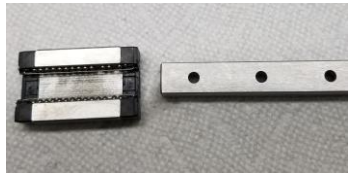


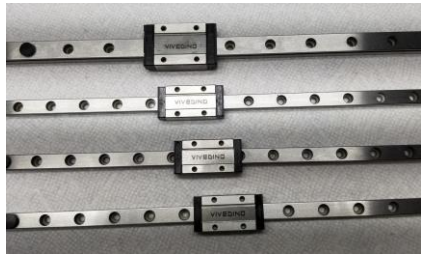


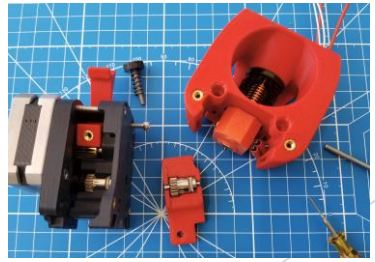


Mechanical Assembly Preparation



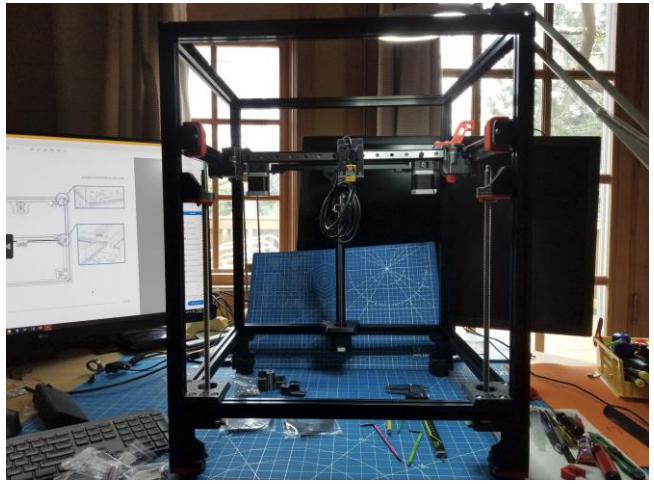


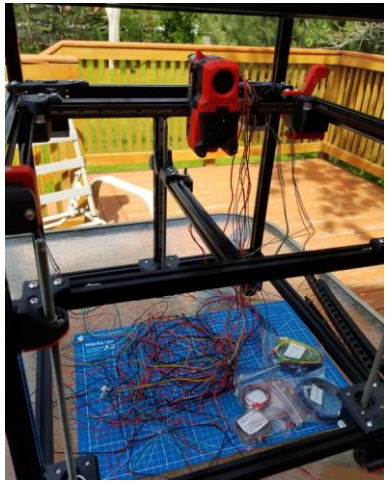


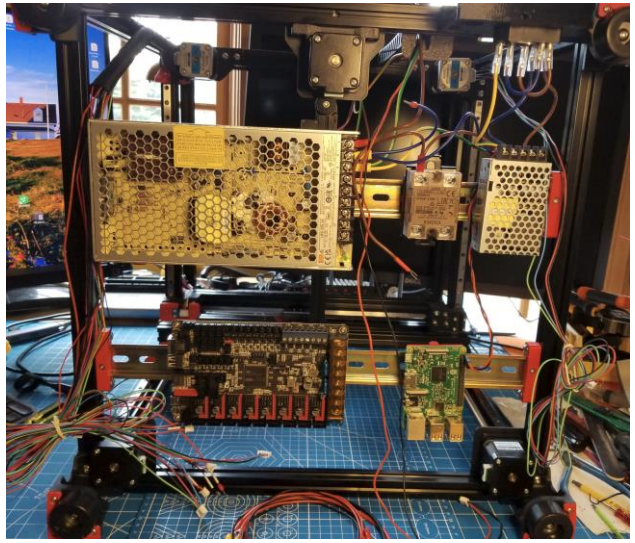


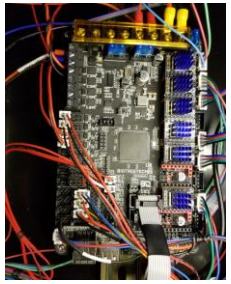
Printer Build

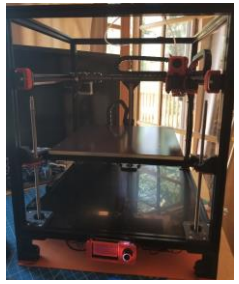
- Mechanical Assembly
- Electrical / MCU (Octopus) Setup and Wiring
- Software Installation (OctoPrint / Klipper)
- Software Configuration
- Initial Startup Checks (End Stops, Motors, Heaters, Probes and Sensors)
- PID Tune Bed and Hotend
- Z-Tilt Automated Bed Leveling
- Super Slicer Setup

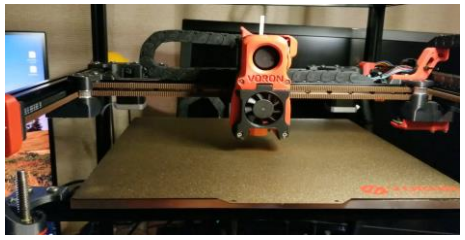


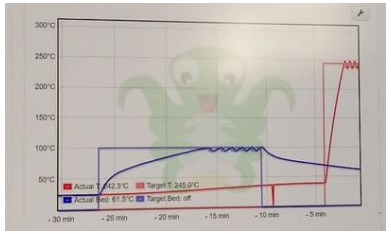












First Prints

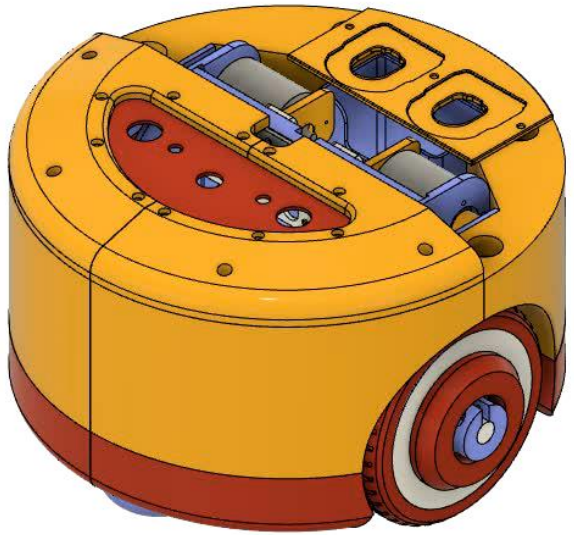
Finishing Prints

Final Assembly – Ready to Print Robot

Robot – Design

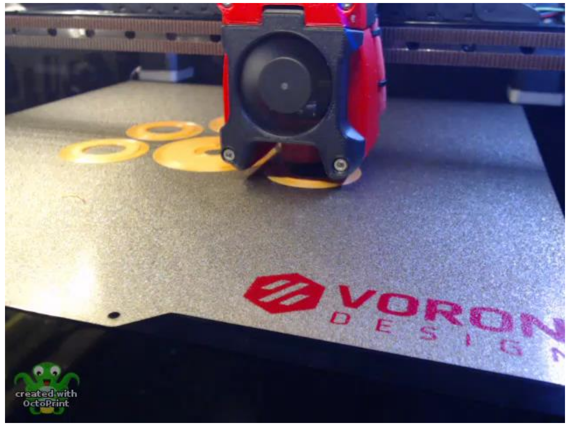
Based on open source RUR design ("Really Useful Robot" by James Bruton)

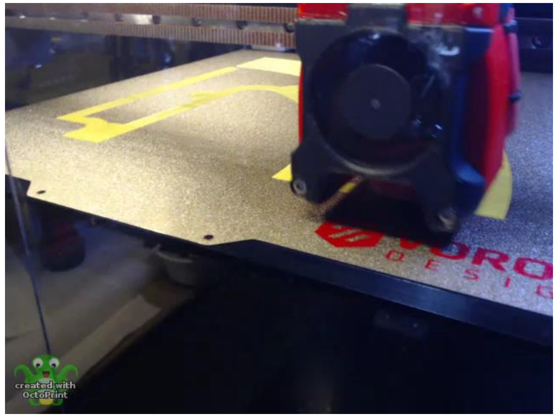
- Designed holders for magnetic encoders and RYOBI ONE+ 18V batteries
- Modified motor pulleys for 8mm diameter shaft
- Split robot body into upper / lower pieces to gain access to the drive system
- Customized switch / power monitor plate

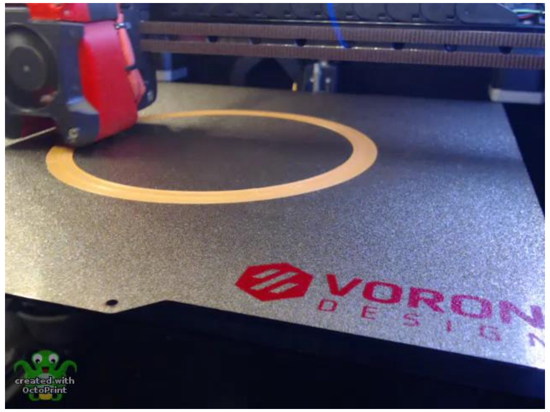


3D Printing Robot Base

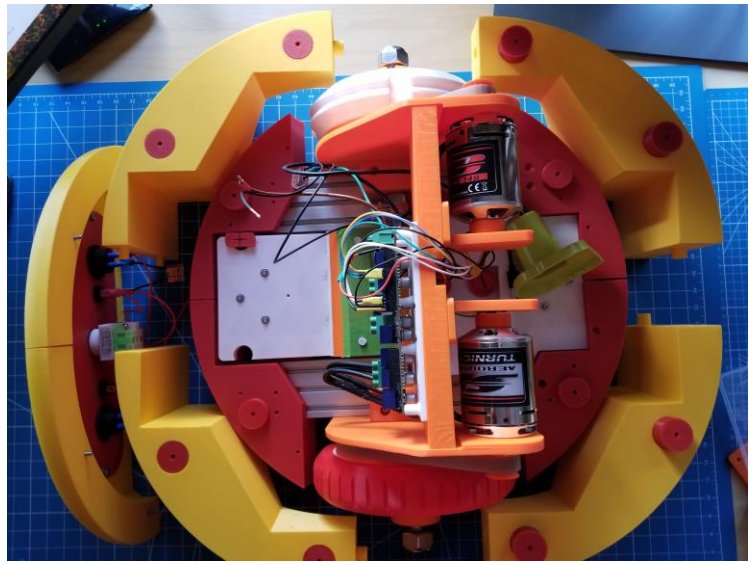
- Structural elements - ASA
- Upper / lower body elements – PLA+
- Tires - TPU

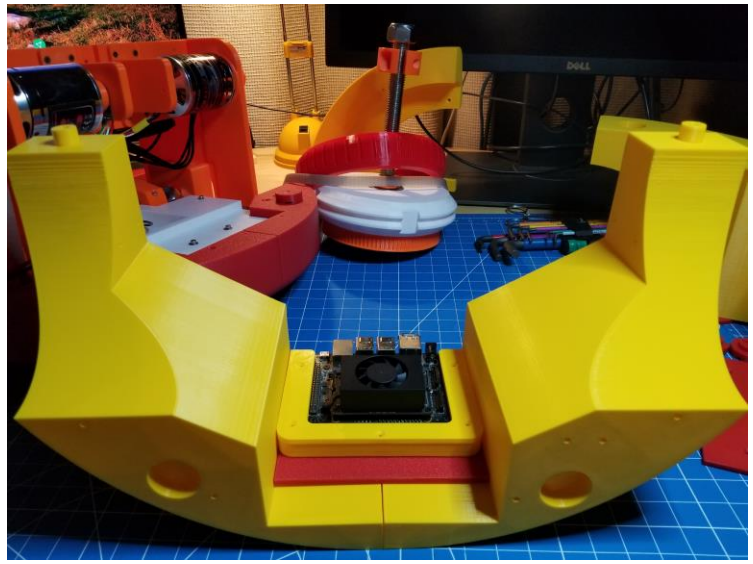


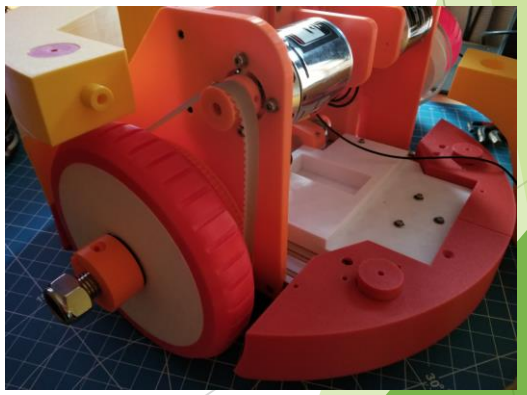




Robot Assembly

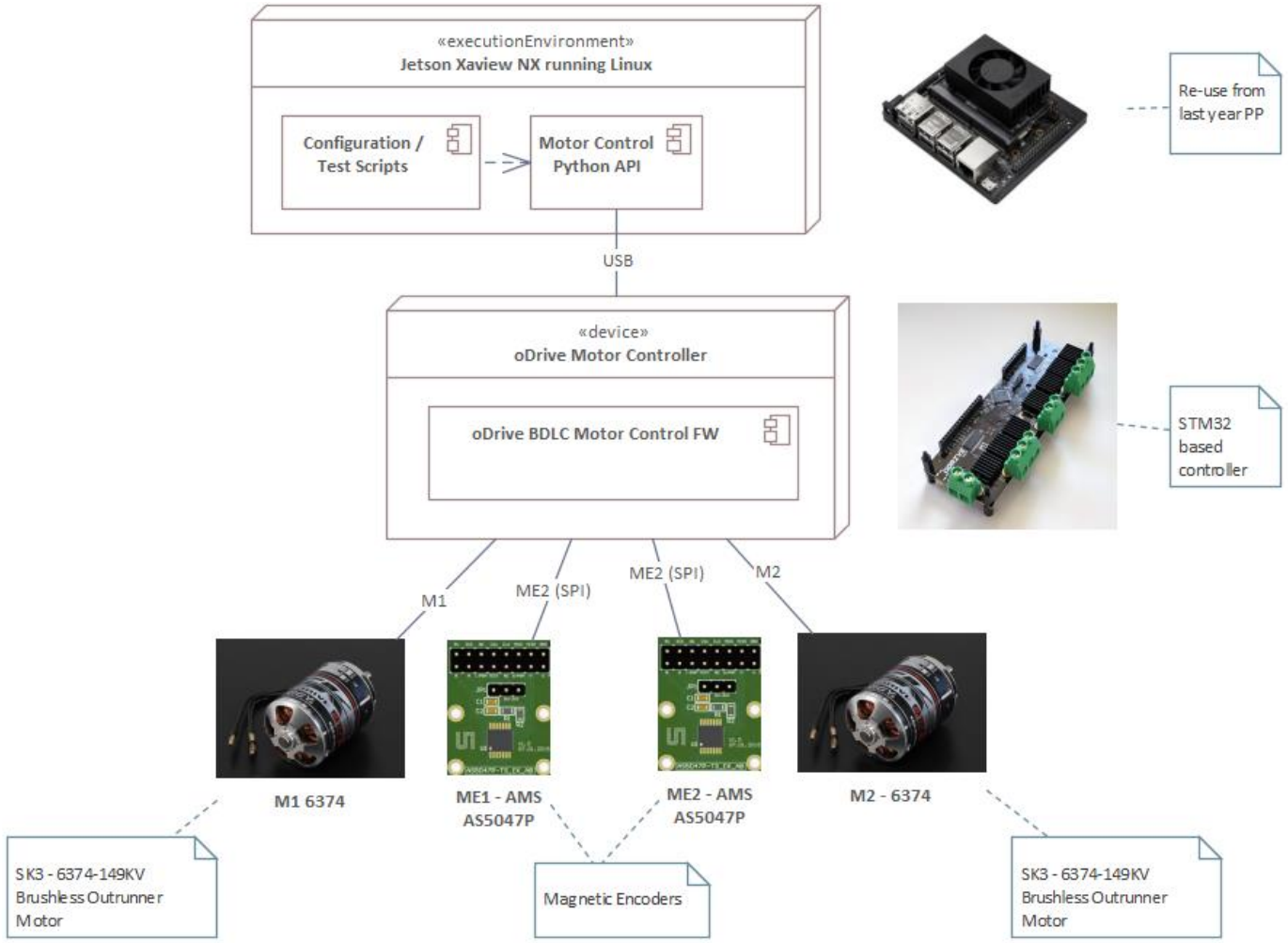






Test Runs - Demo

Robot - System / Motor Control



Lessons Learned

- Learned Fusion 360 fundaments, sketching, 3D modeling and how to design simple parts / objects
- Learned 3D printing fundamentals and printer designs
- Learned how to build / configure and calibrate CoreXY printer
- Learned how configure slicer, create printer and filament profiles; slice, customize and and generate effective g-code for 3D print
- Project planning / management skills

Budget / Scope Review Against Plan

Budget Review

Item	Plan	Actual
SK3-6374 BLDC motors	100..220	102.60
ODrive 3.6 BDLC Motor Controller & Magnetic Encoders	210..250	116.66
PLA, TPU and Casters	90+2x35	72.33
2060/2080 Aluminum Extrusion x 300mm	24..30	19.84
extra PLA+	-	47.98
ASA, 22AWG wire, M3 screws, bearings	-	79.84
Switches, battery power adapter & monitor	20..30	59.52
Total	465..500+	498.00

Scope Review

Work Item	Plan	Challenges
Printer build	Order parts ahead of time , print essential parts on HPT printer, build basic printer and use it to finish parts printing, fine-tune	Way more work than I planned. Printing ASA parts without proper enclosure was challenging.
Robot build	Print parts, assemble and as bonus add basic motor control	Printing PLA parts was going smoothly. It was challenging to print tires in TPU without support. Challenge was to adjust magnets in center position and optimal distance from encoder chip.
Fusion 360 learning / design	• Design holders for magnetic encoders and RYOBI ONE+ 18V batteries • Re-design motor pulleys for 8mm diameter shaft • Split robot body into upper / lower pieces to gain access to the drive system	Extra work to redesign tire shape to print in flex TPU without support.
HW / SW configuration and setup	• Configure and setup printer HW / SW • Jetson Linux setup, motor control configuration and demo / configuration script development	All Software configuration / setup was as planned.

What would I do differently?

- Re-design drive assembly to add more room for wheel drive belt tensioners
- Re-design motor / encoders mountings to simplify encoder center position / distance adjustments
- Buy printed parts for initial printer assembly

Q&A

Thank You