



Fast Cold Brew

The Team:

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What was the project?

Answer: we made a kitchen-countertop device that can make quality cold brew coffee in 3 minutes at the touch of a button!

Also acceptable: think Keurig for cold-brew!



Overview

- Requirements
- Scope
- Early Design
- Design Process
- Current Design



Fast Cold Brew

Requirements

- Hold 32 ounces of water
- Cool the water to 8°C within 30min
- Brew coffee for 3 minutes
 - Key elements are -14.5 psig pressurization and physical agitation
- Deliver 10°C coffee in servings of 8, 12, and 16 ounces
- Provide an intuitive interface for the user





Fast Cold Brew

Scope

Generate will design a novel cold brew system system capable of self-contained cooling and circulation.

This system will consist of a four parts: the recirculation & refrigeration mechanisms, the vacuum chamber & filter, an insulated water tank, and a power/control system for automation.





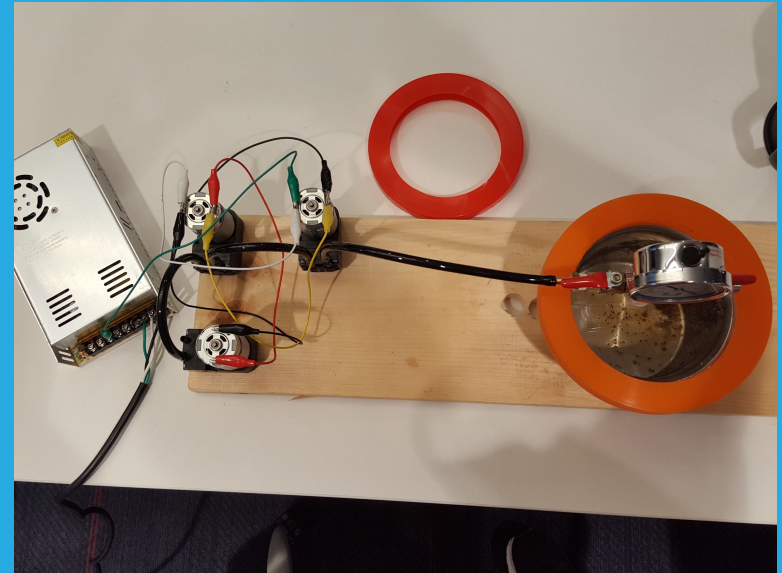
Where did the project start?

Our client had a works-like prototype, shown below



Before they arrived in Generate, our client had developed a technique for cold brewing coffee under vacuum.

Using Amazon.com and a vacuum chamber, vacuum pumps and a power supply, they had achieved cold brew manually in 3 minutes.





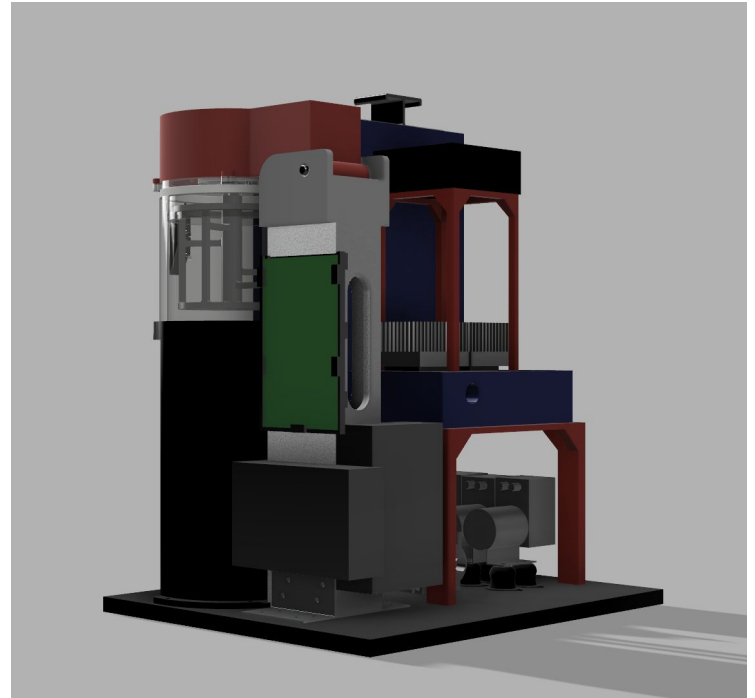
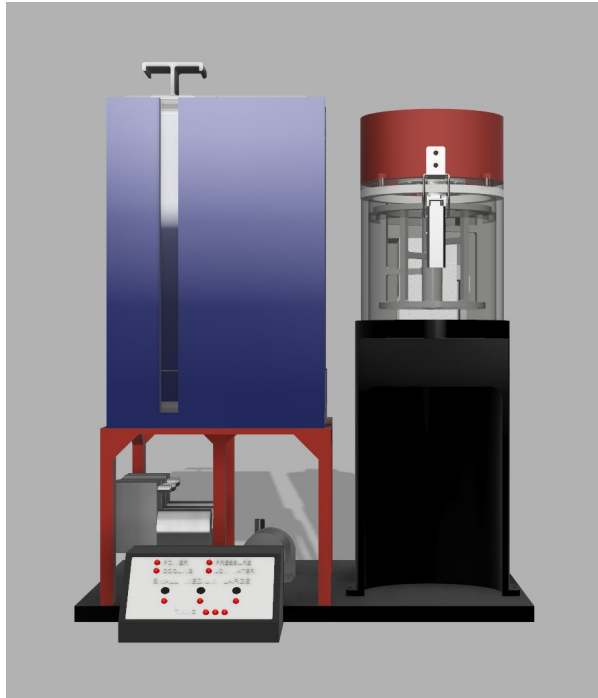
Our Design - CAD

- Two guiding philosophies: a refrigeration cycle and a brewing cycle
- Refrigeration cycle recirculates water in the storage tank while cooling with peltiers and dissipating heat with fans
- Brewing cycle pumps water to brewing chamber, pulls vacuum in chamber, and controls the motor
- Front-facing UX and controls with low water, low pressure, and insufficient cooling warnings





Our Design - More CAD

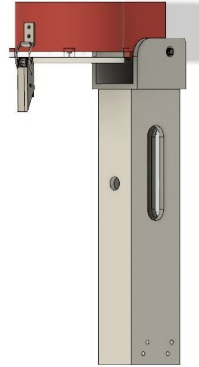




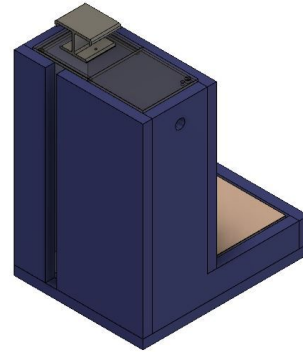
Product Sub-assemblies



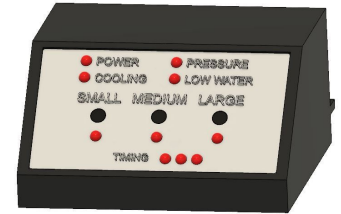
Brewing Chamber



Hinge/Lid/Post



Water Tank

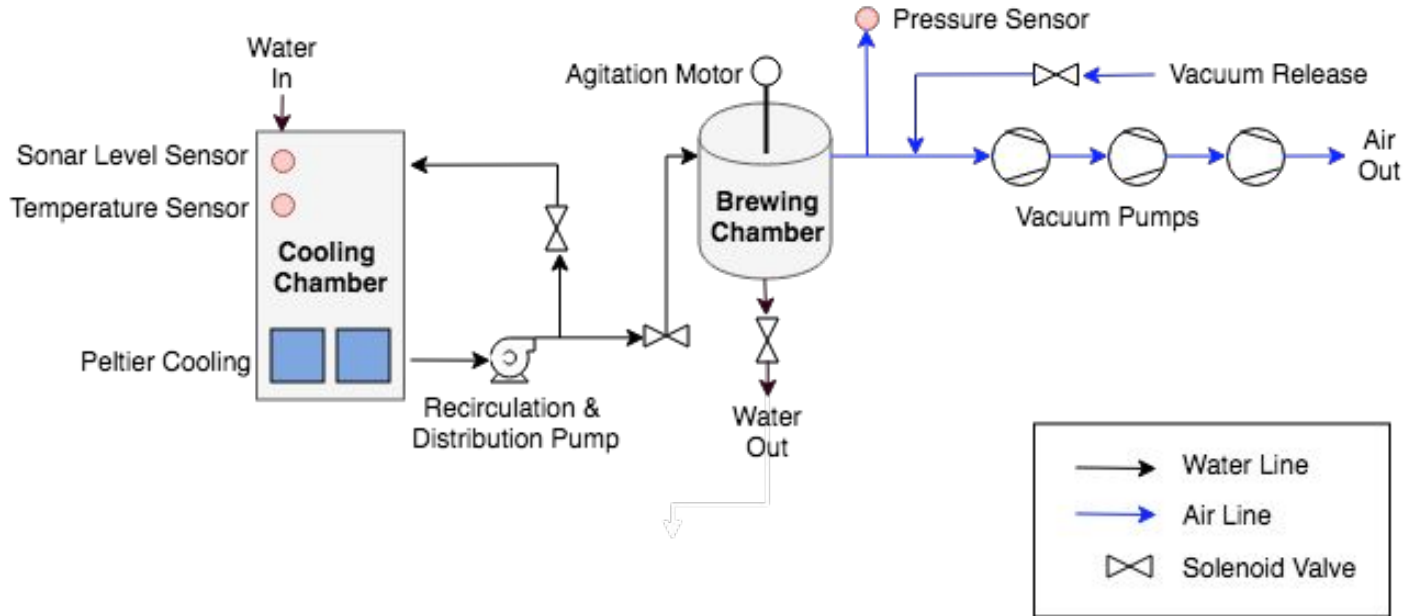


User Interface



Process Flow

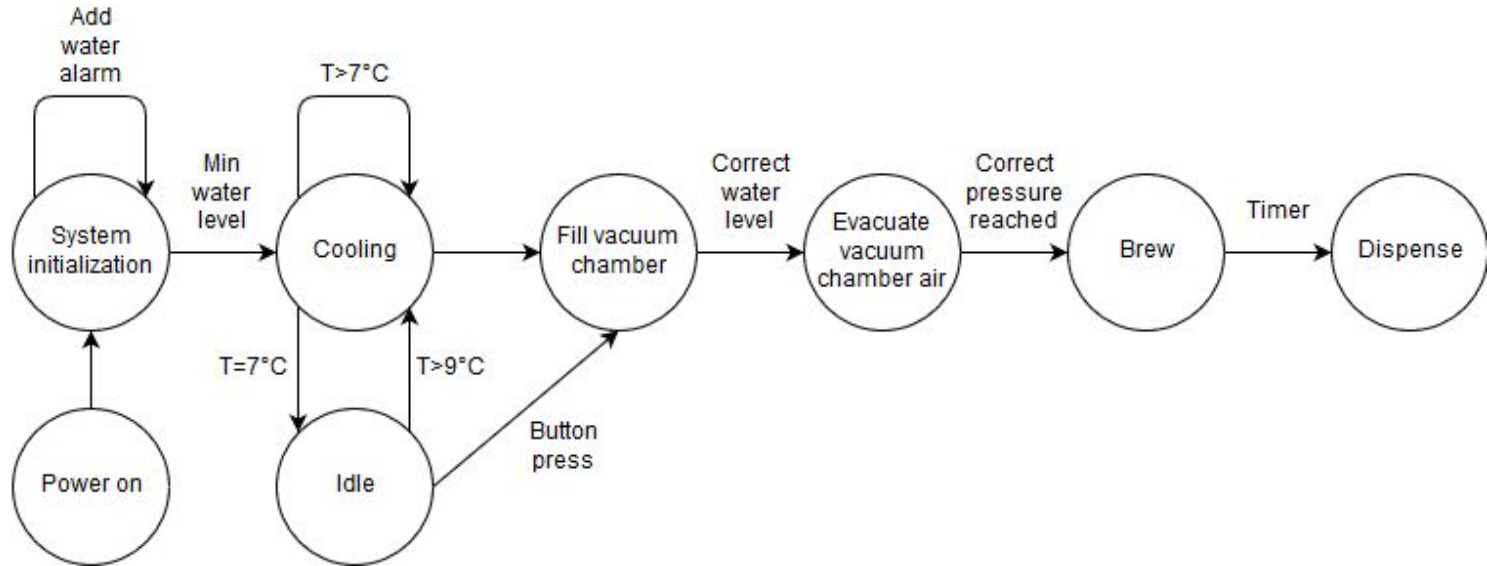
Fast Cold Brew PFD
Demo Day
December 5, 2018





State Machine

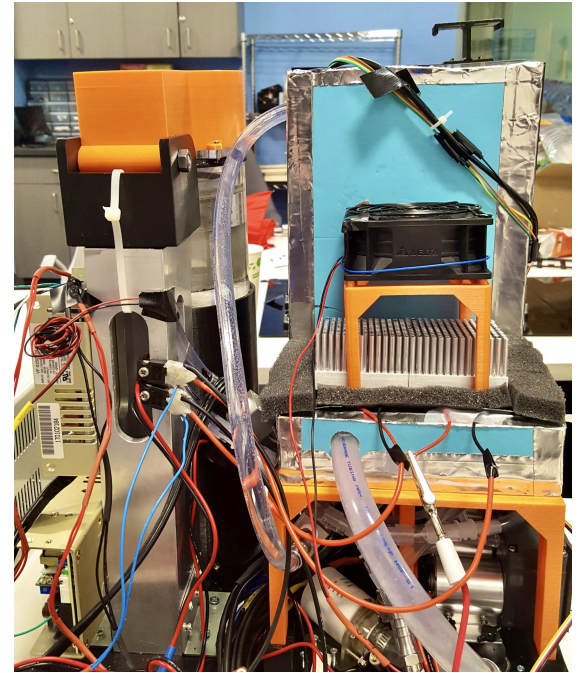
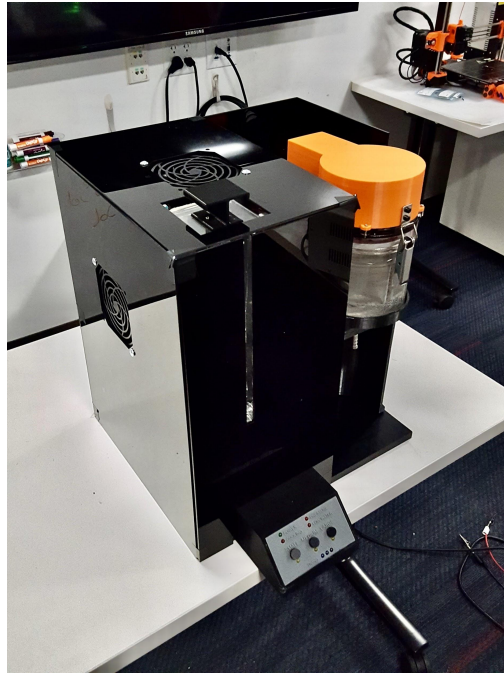
State Machine





Inside vs Outside

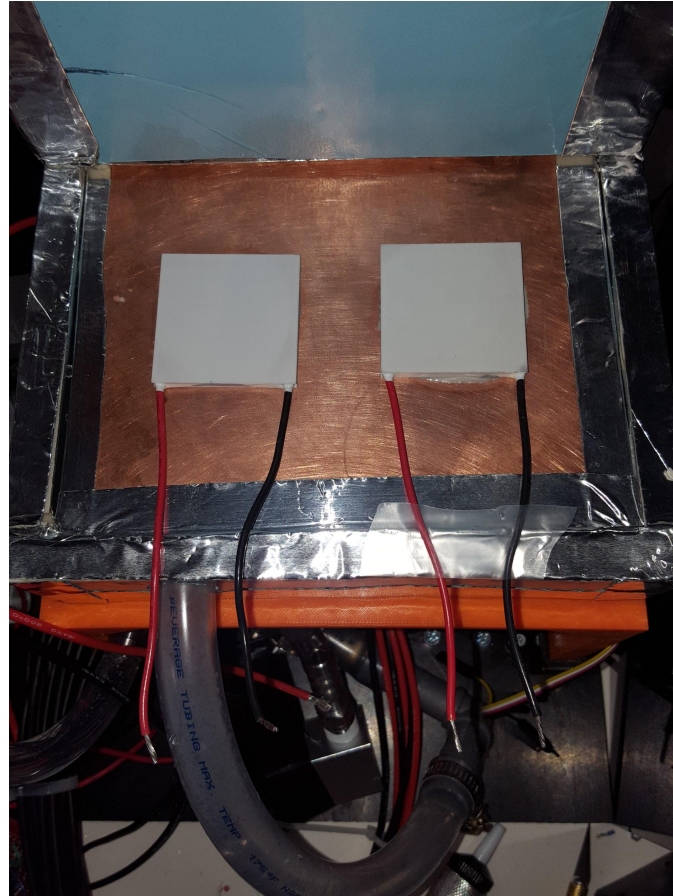
The real world is messy... the gorgeous reflective black acrylic hides some gnarly innards





Peltiers

On sanded copper with
thermally-conductive
adhesive



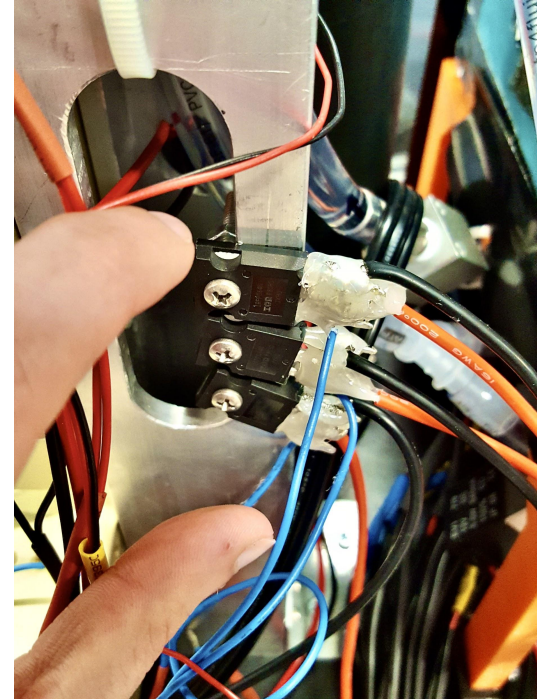
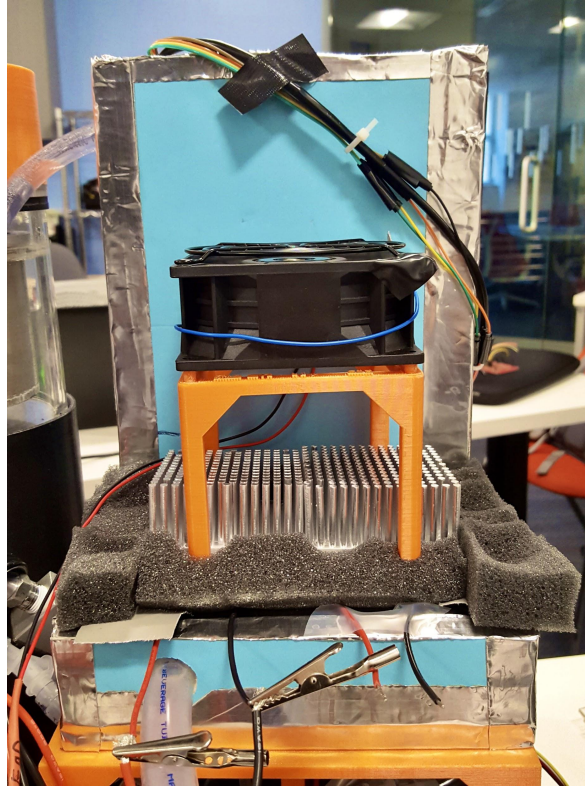


Peltier Cooling

Heatsinks and fans
needed to cool the hot
side of the Peltiers

Peltiers controlled via the
N-channel power FETs

FETs mounted to the
aluminum post for
thermal dissipation



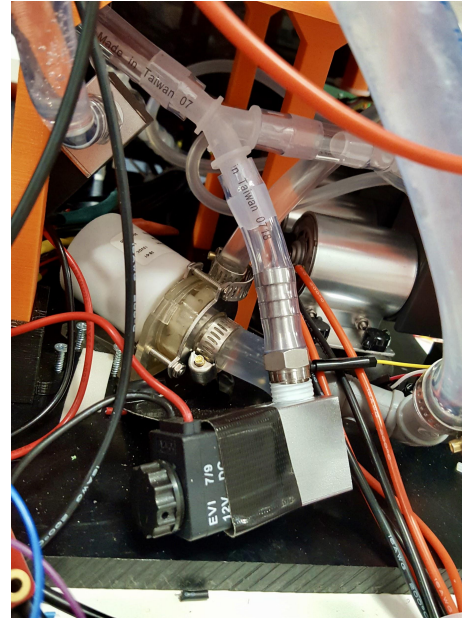


Moving Air & Water

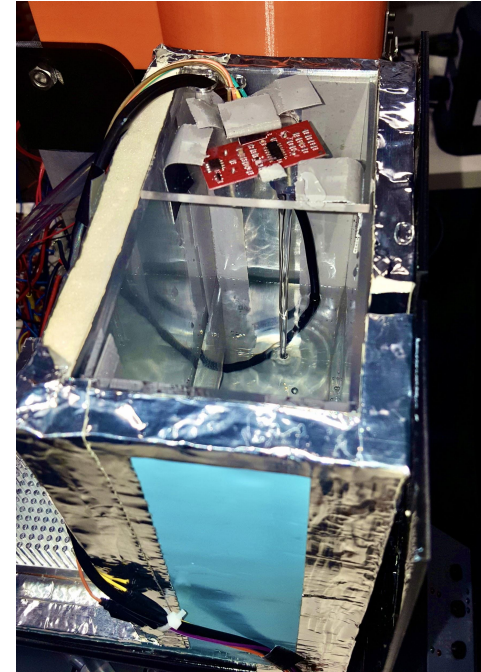
Vacuum Pumps



Solenoids & Water Pump



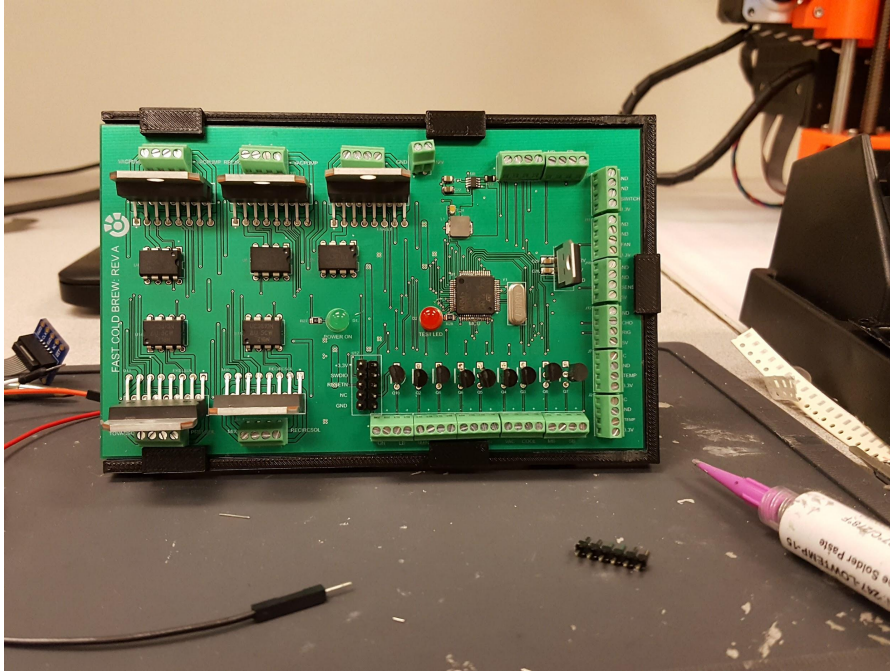
Sonar Sensor





The Brains

Printed Circuit Board



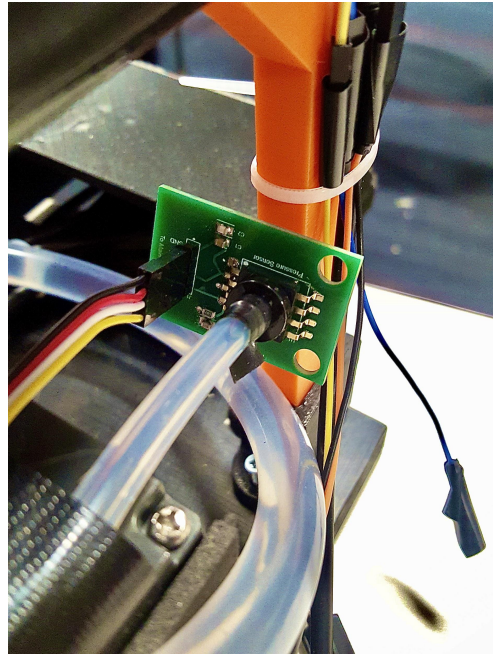
Schematic





Electronics Learnings

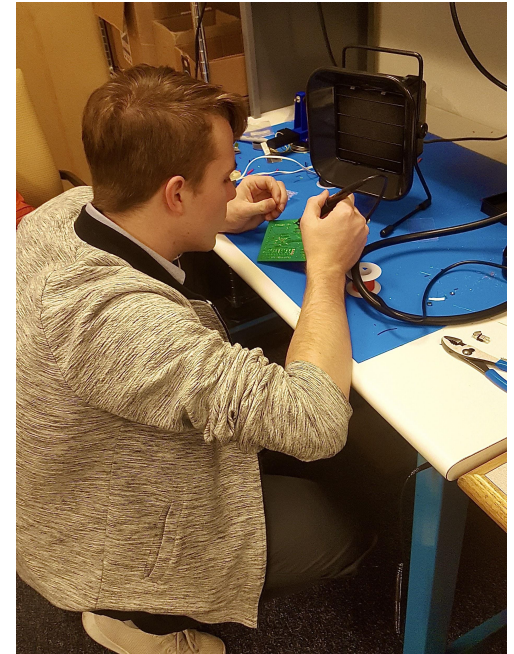
Expensive pressure sensor needed a breakout board



Don't overtorque your motor

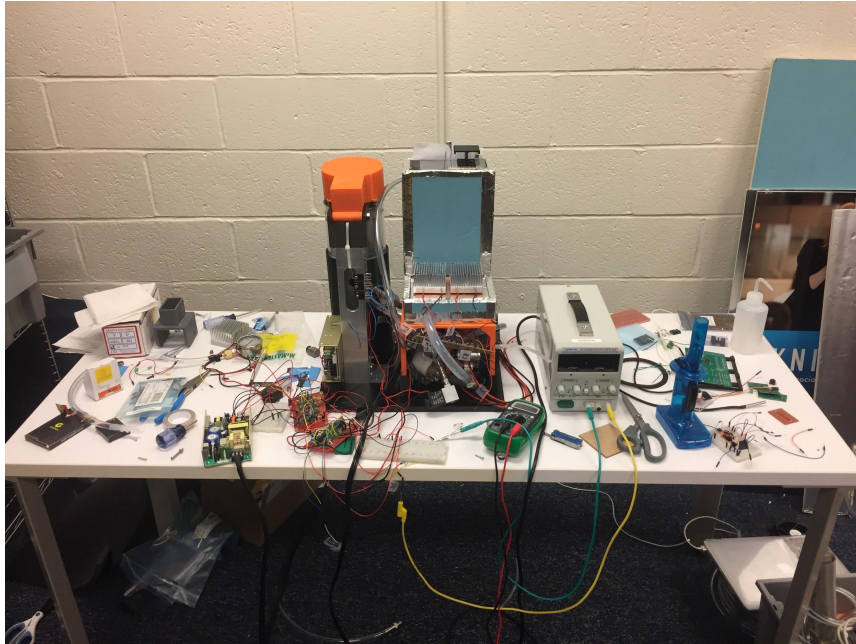


Sometimes paying for assembly is worth it





Major Design Challenges



- Refrigeration and heat dissipation with our Peltier cooler proved difficult
- Food-safe fabrication and low-cost prototyping methods can appear like oxymorons
- Breadboarding and proto-boards quickly became overwhelmed with wiring to every subsystem
- Maintaining a water-tight vacuum seal

Where we're at



Video Demo





The Team





generate

Appendix

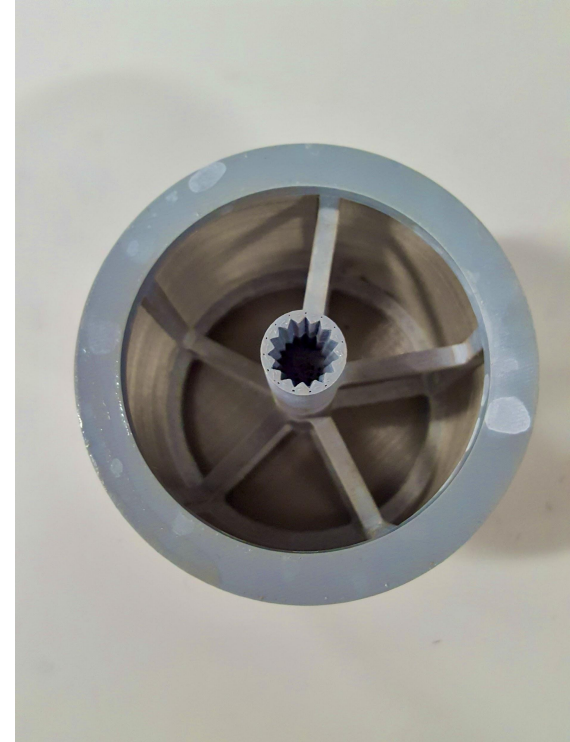
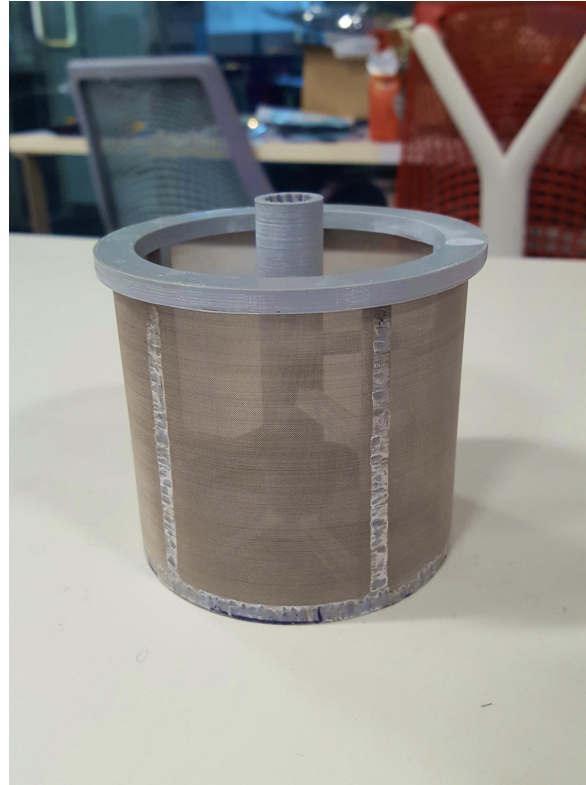


Filter

Finely-spaced filter to prevent coffee grinds from clogging the machine

3D-printed spokes and housing for agitation

Socket for motor to gain leverage to spin the filter





User Interface

LEDs for status updates

- Power
- Needs Cooling
- High Vacuum Chamber Pressure
- Low Water

3D-printed buttons for user input

3D-printed outside shell

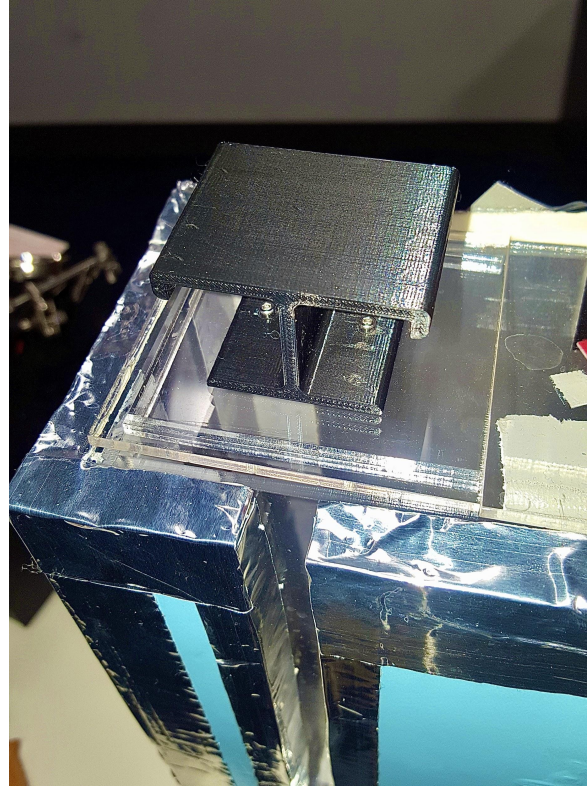




The Lid

3D-printed handle

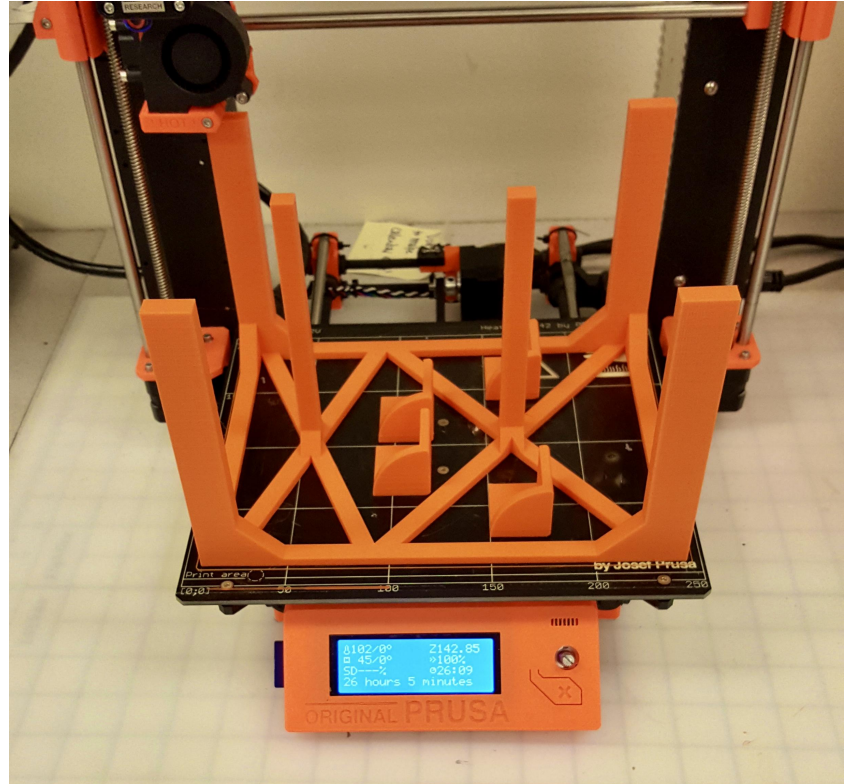
Acrylic base to match the
water tank





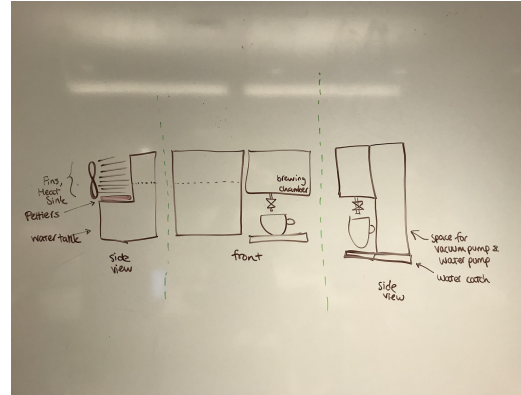
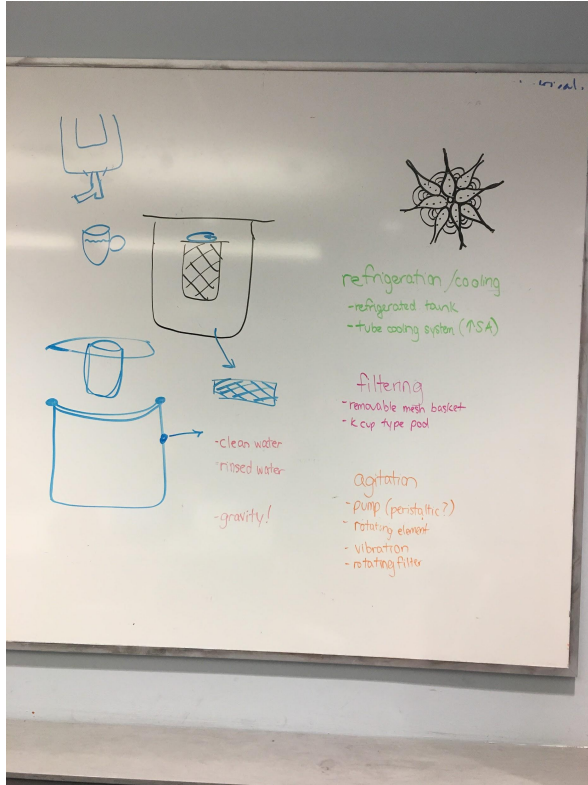
3D Printer

Original Prusa, shown with our table for the water tank being made

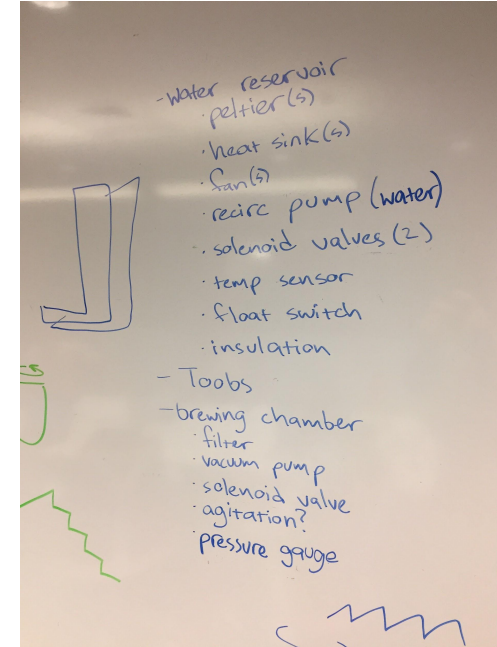




White-Boarding

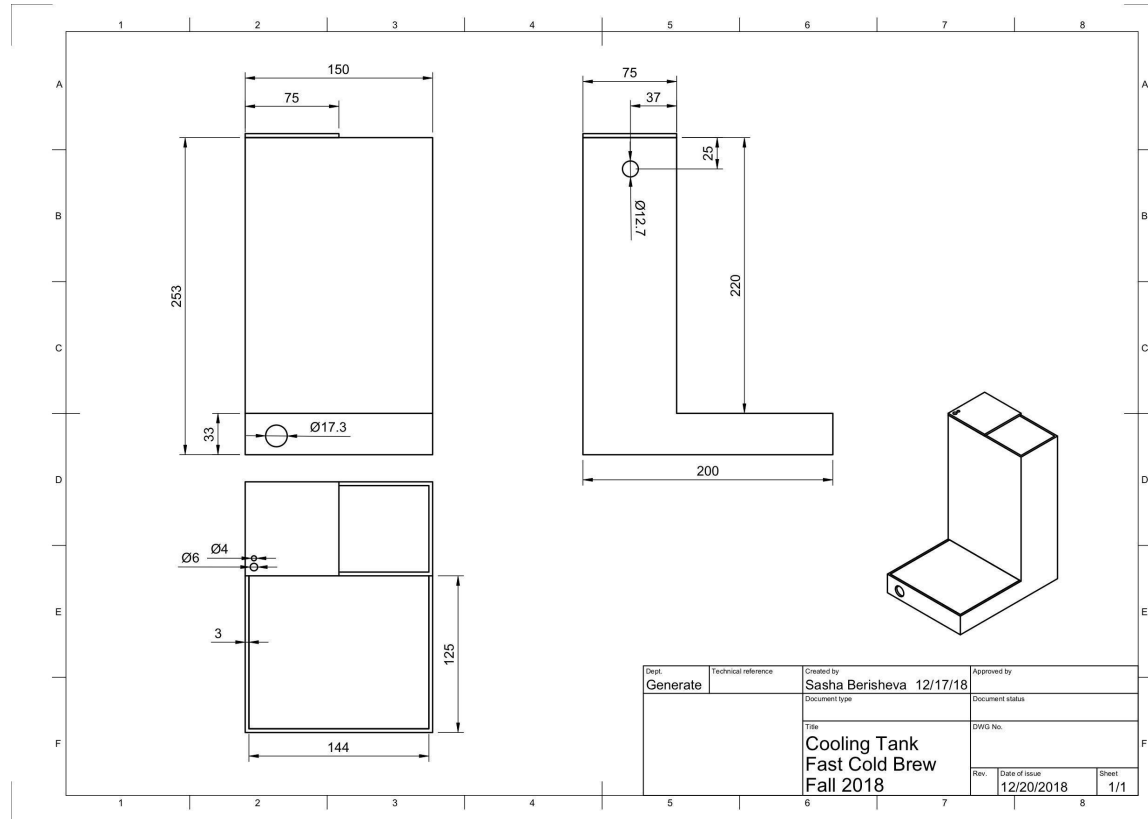


Creativity at work





Acrylic Housing Dimensions





Without the Housing

A pretty inside matters, too

