

READI-Net Instrumentation Update

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December 9, 2024

Feb 28, 2023



Lessons learned from various experiences

- At February 2023 MBARI meeting, you helped define

Design for the average:
MOSCOW groupings:

- MUST have's
- Should have's
- Could have's
- Won't have



MoSCoW

Hardware

- Components of ESP associated with collecting, filtering and preserving water samples.
- e.g., size, weight, sample capacity

Software

- Programs used to communicate between the user and the hardware
- e.g., web-based vs app-based, calendar vs spreadsheet

Must have

- Required for product to have expected outcome; minimum viable product

Should have

- Requirements that will improve product, but product can work without them

Could have

- Requirements that are desirable

Won't have now

- Requirements which will not be included this time, but will be considered for future iterations



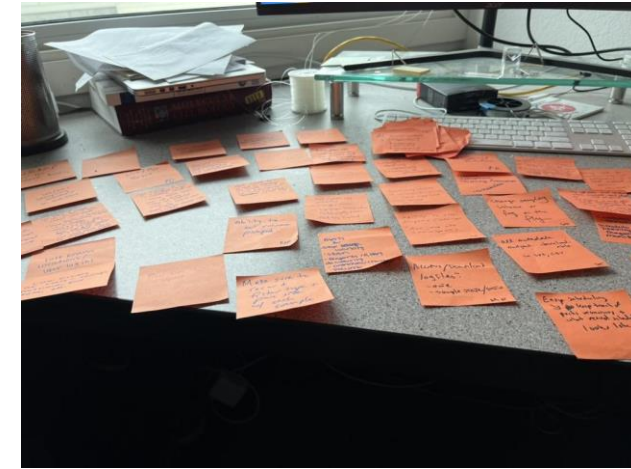
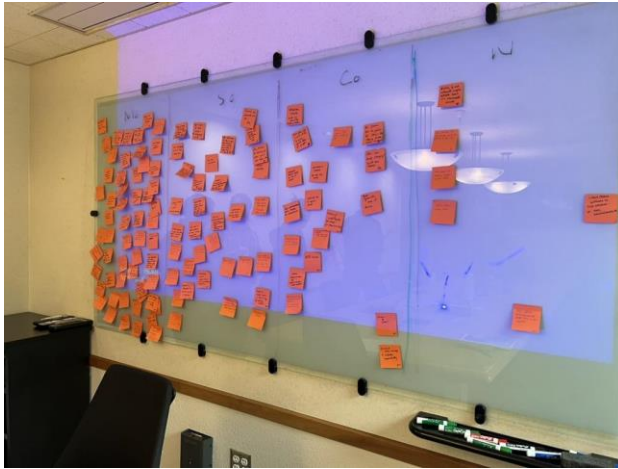
Removal order

Balancing the “Haves”

(Must, Could, Should, Won't)

- Ensuring alignment with objectives, timelines, and resource availability
- Prevent overcommitment by limiting "Could Haves" and "Should Haves"
 - Prioritizing Input/Output Interfaces and Modularity – flexibility for future updates
- Define "Won't Haves" to safeguard core deliverables
 - Adversely impact impact size, cost or significant development time

MoSCoW Exercise



Must Have's	Should Have's	Could Have's	Won't Have's
Inexpensive sampling (\$100/sample - \$300/sample w/labor)	test/run button	low power - battery and solar powered	versatility - 1 unit -> many functions
4-6 week servicing, 60 - 90, 100 samples	easy to open pucks and access filters (no special tools)	backpack portable	fits in a Hoffman box (2' x 2' x 10")
deployable by 2 people or fewer	modular components - repairs/puck replacement	flexible option for power and communications	Hardware for securing/attaching to structure
Easy to setup with minimal experience	Temperature tolerance -115F to ice in/ice out	Sustainable design	waterproofing (flooding)
Easy maintenance - non expert, common tools	Jostling insensitive	eRNA capabilities	Weatherproof
durability/weather, etc, balance ease of setup	Fix check-list or a troubleshooting tree	particulates and silt	transponder
No nitrogen purging or an easier way	fit within agency requirements	Include filter blanks	security lock (prevent tampering)
postive pressure sample	compact carry on suitcase	Planned permanence of replacement materials	saving filtrate
high sample integrity - no cross contamination	contamination controls - tubing etc and blanks	sample less than .5 min	cold weather operations - heated intake lines
Easy sample retrieval or filter replacement w/ minimal risk for contamination	backup cartridges	sample partition	\$9K per instrument
keep samples/pucks clean	built-in instructions	ready-to-go service kits for field servicing (filters, blanks, gloves, reagents)	rental
preserved filters go right to storage	refill cartridges even if not empty	Remote deployment without supporting infrastructure	USB-C (or other connection) for data retrieval
Decon itself	replace with new cartridges	communication without disassembling	pre-filter for clogging
Decontaminate tubing between sample collection	sample time < 1 hr	training to change cartridges (reagents)	prefilter to help sampling
Multiple modes of communicating (WiFi, Bluetooth, Sat/Cell, Ethernet)	water sample 1L		operations in freezing conditions
easy to sterilize			filter agnostic - both form and media - ie. sterivex
reusable - only reloading filter (\$0.50)			Alerts when stream is dry
shelf stable chemicals for long term storage			capability to pump long distances
see status when walking away (green light)			covariate collection - chla, ph, turbidity, temperature (air, water), sample volume
can retrieve/refill cartridges easily			ability to collect samples in different sediment conditions (sediment levels)
			water quality sensing
			possible to make cryptic and hard to notice if needed to place in location without security
			2 samples independant with respect to collected concentration (e.g. no temporal correlation due to contamination)
			Sampling at multiple place along stream width
			synchronous replicates
			time to filter < 5 min
			sample and logging display
			Lysis
			multiple intakes for differing depths
			"sample" flow through
			pumps to have concurrent replication
			remote installation - solar powered + battery with satellite communications
			increasing flow rate (temporal scale of one sample)
			lyophilization
			Lysis

Focus Design Requirements

Hardware

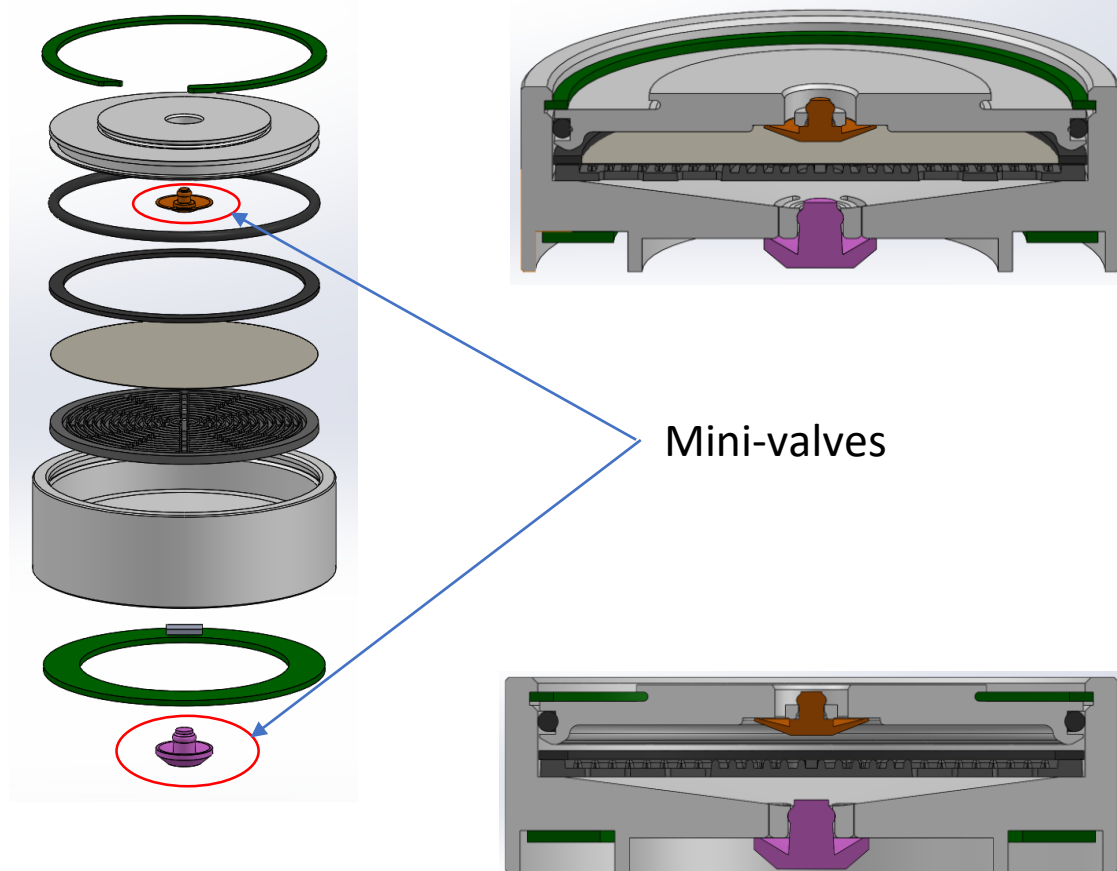
- Inexpensive (< \$30K)
- 100 samples
- Deployable by 2 people (max)
- Simple setup and maintenance
- Decontamination of system
- Multiple communication options (e.g., WIFI, Bluetooth, Cellular, Satellite)
- Maximize sample volume (1L)

Software/UI/UX

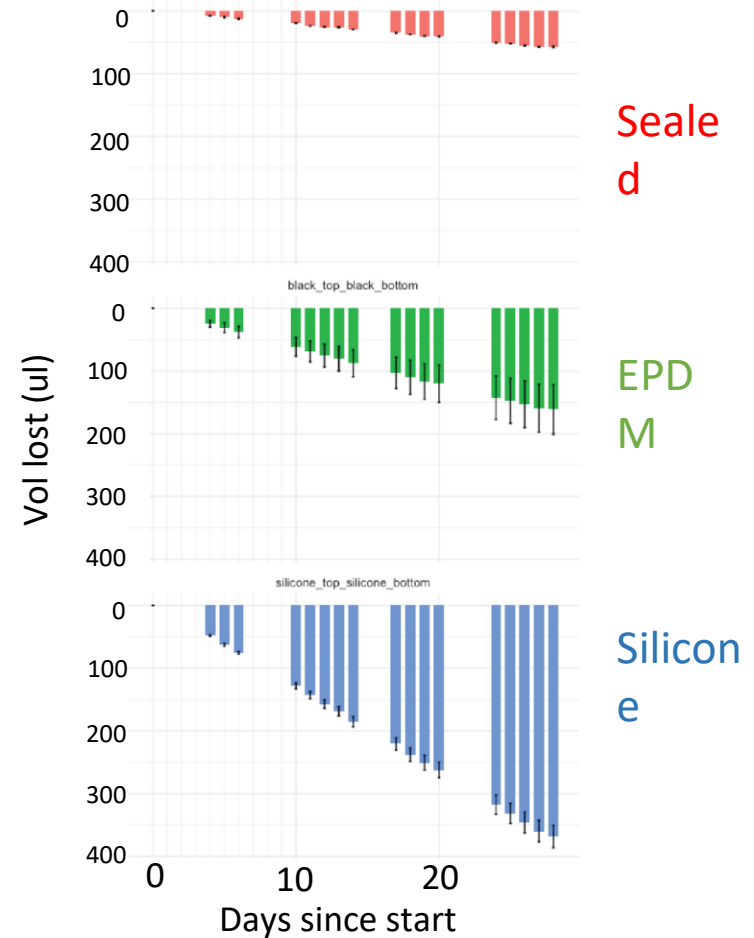
- Simple Web-based GUI
- Sample-specific data logging (volume, date-time stamp, flowrate)
- Two-way communication
- Manual and Schedule-Based Sampling
- Instrument State (Current State)

Testing

Puck design is locked-down.



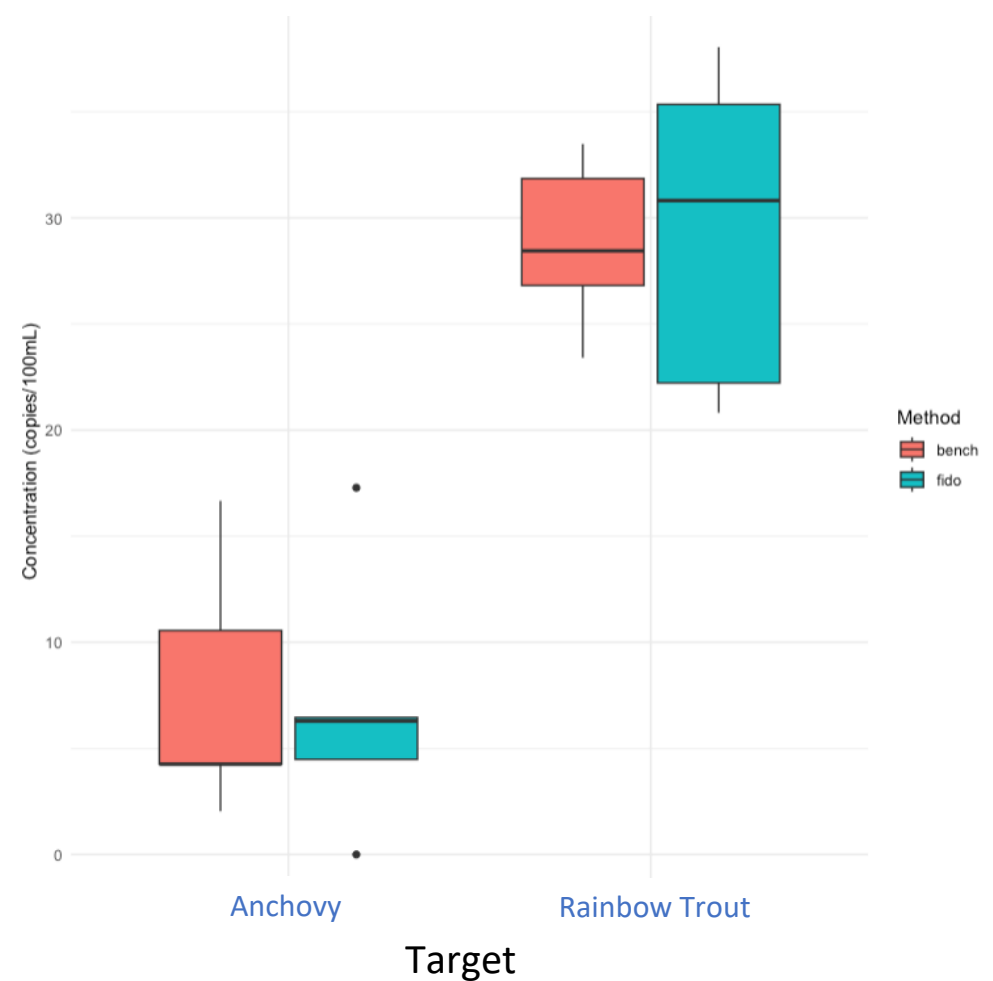
Effects of different materials on evaporation within filter housings



Larger Filter Validation



Validating Recovery of Target DNA for 47 mm filter housings



Iterations with larger filter size

June, 2023



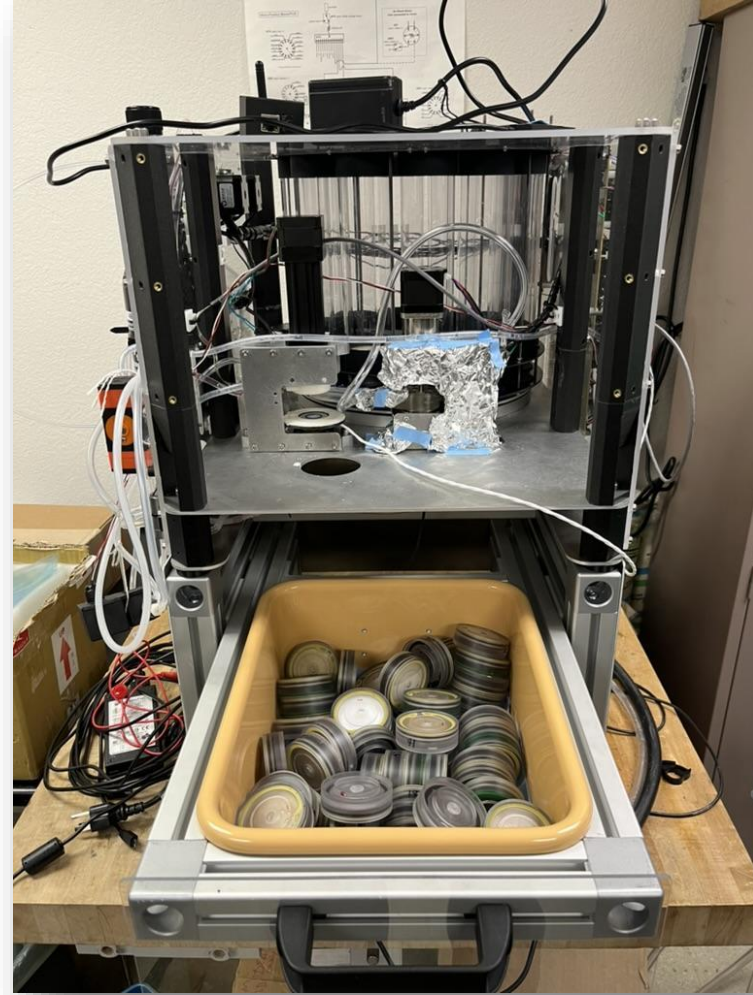
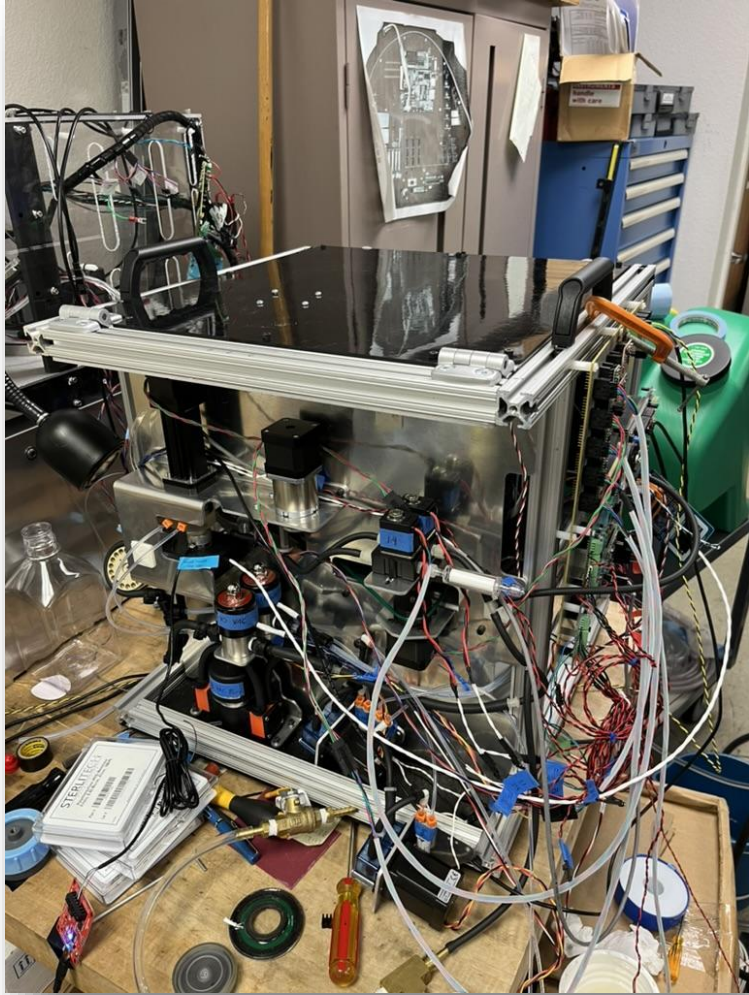
- How to store and move pucks?
- How to clean?

Refining concepts

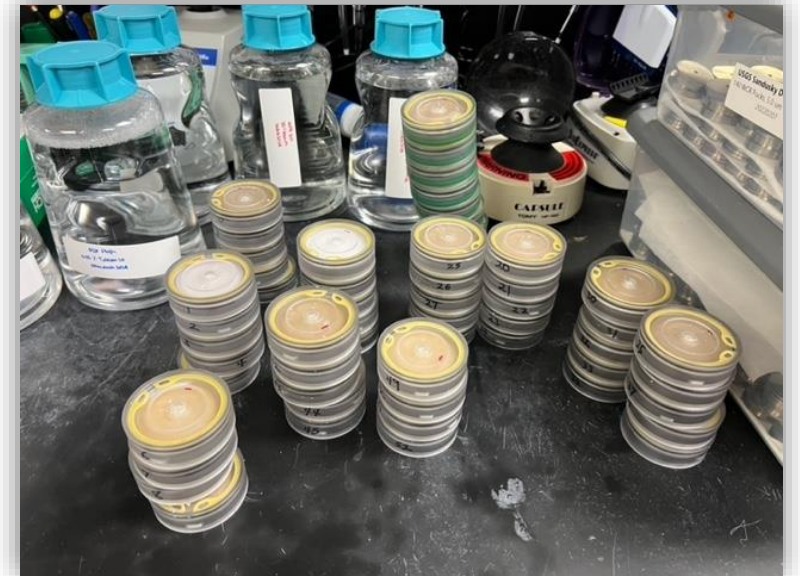


Further refinement

Fall, 2023

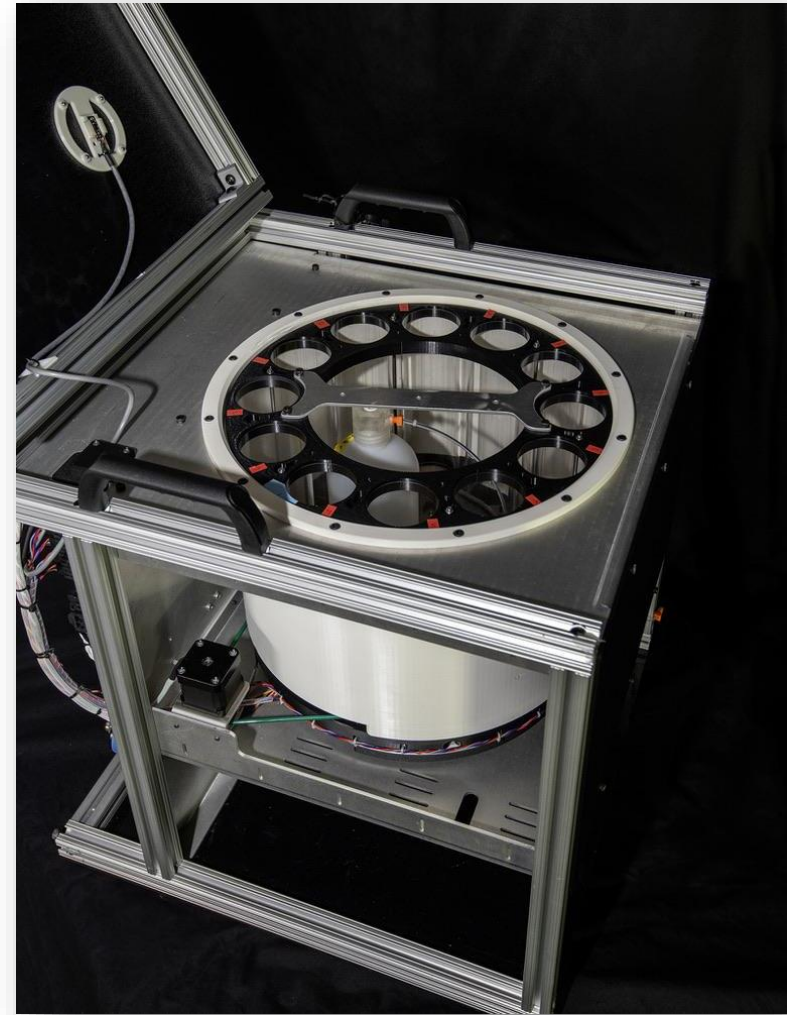
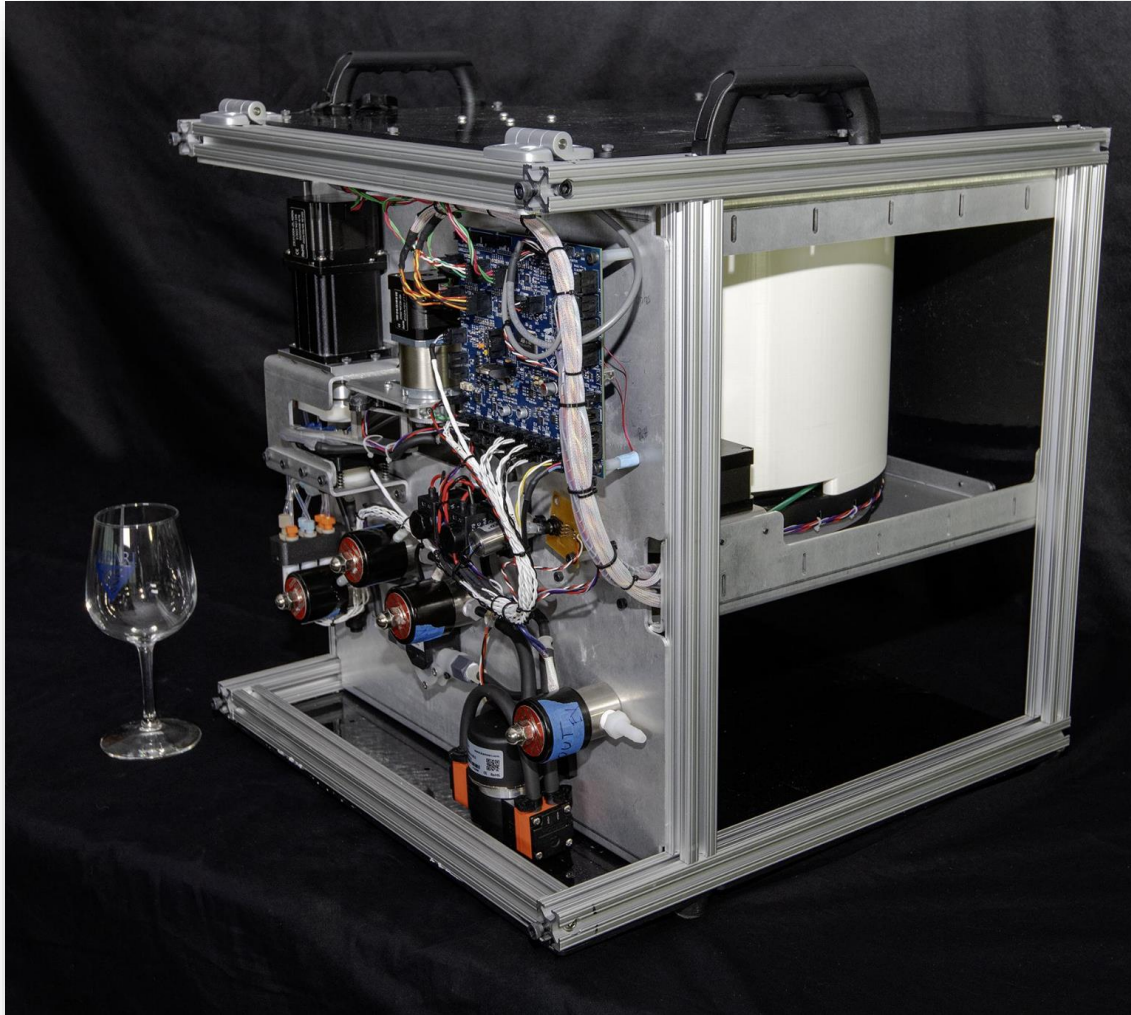


Dock deployment—First ‘Field’ test!



...so where are we now (Dec, 2024)?

FIDO: Purpose Built / Simple Approach

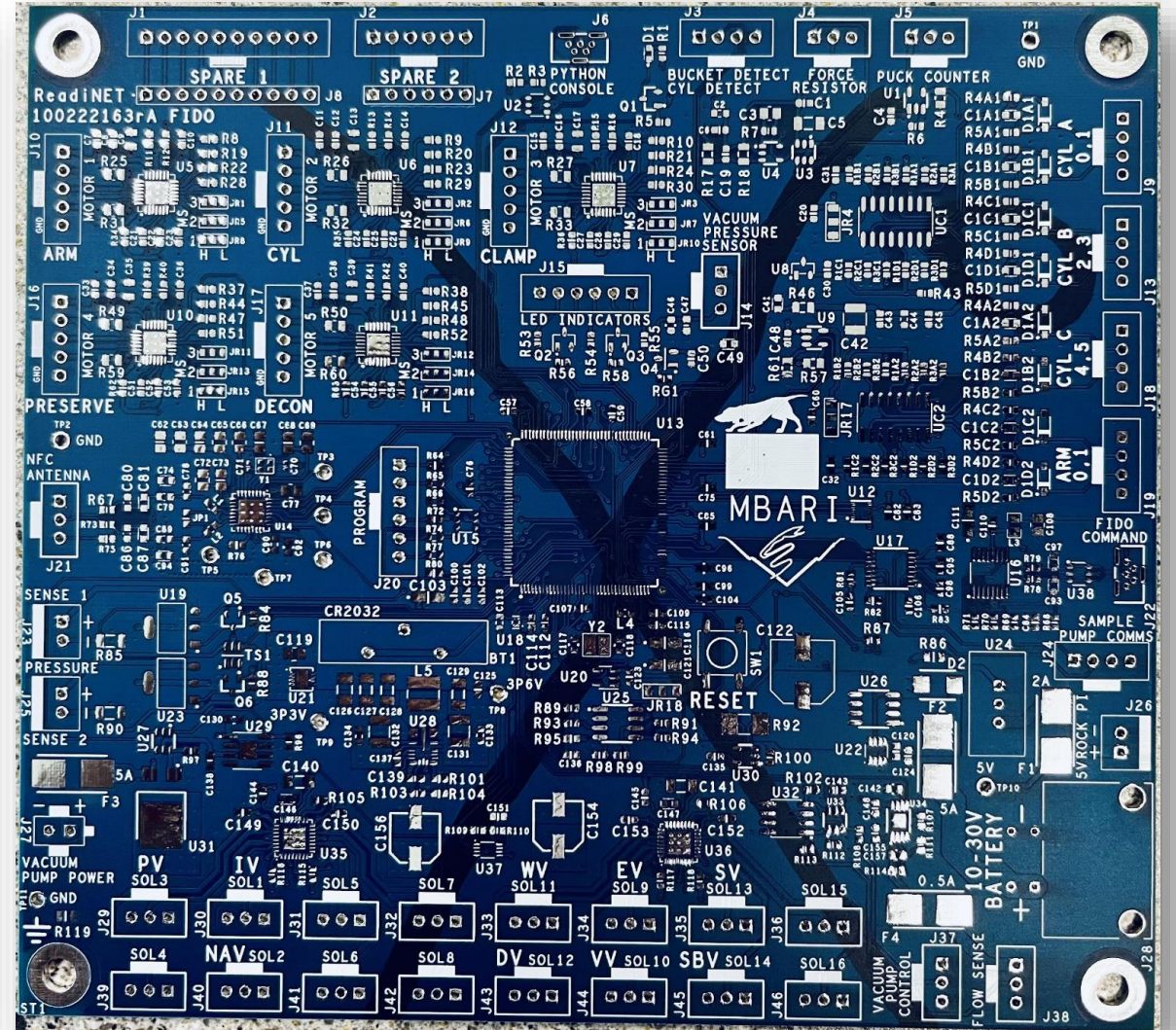
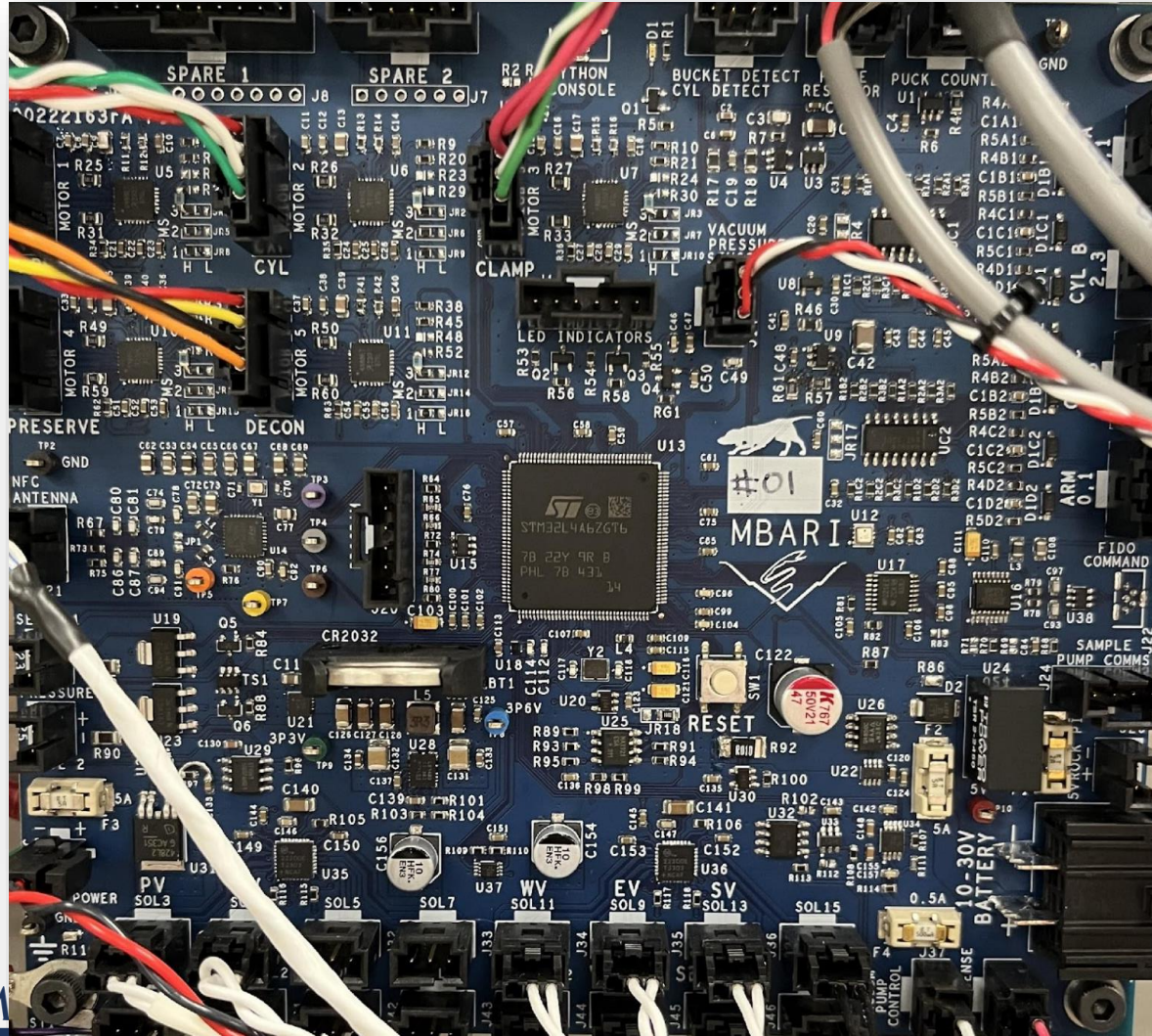


April 9, 2024 

FIDO: Purpose Built / Simple Approach



Control Board is finished



Designing User Interface

FIDO User Interface

Manufacturing review is underway

219 DESIGN

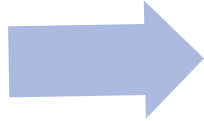
509 6th St., San Francisco, CA



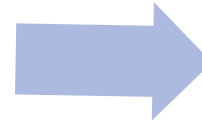
<https://219design.com/>

Looking forward...

2024



2025



2026?

- Complete Manufacturing Review
- Begin ordering parts for 10-build

- Build 10
- Testing & Refinement
- Field test prototypes
- Train end users
- Deploy and test

- Further refinement?
- License?
- Wider distribution?



Feb 20-May 2, 2024

Acknowledgements



Scott Jensen-Lead Engineer



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