Public Invention Q3 Report, 2023

-- Robert L. Read (Rob), October 6th, 2023

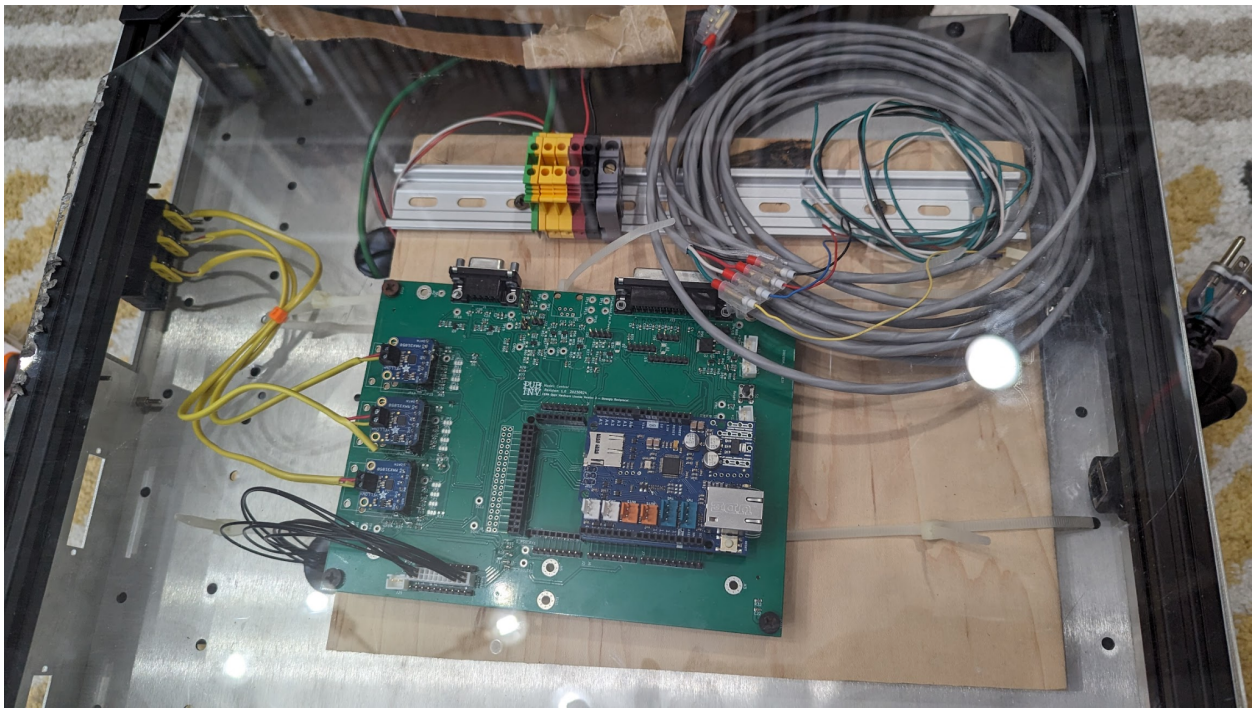
NASA Ceramic Oxygen Generator Project

In August, Public Invention was awarded a $300,000 contract to build a digital control system for a ceramic oxygen generator (COG). This was awarded after the successful completion of a previous $50,000 design contract.

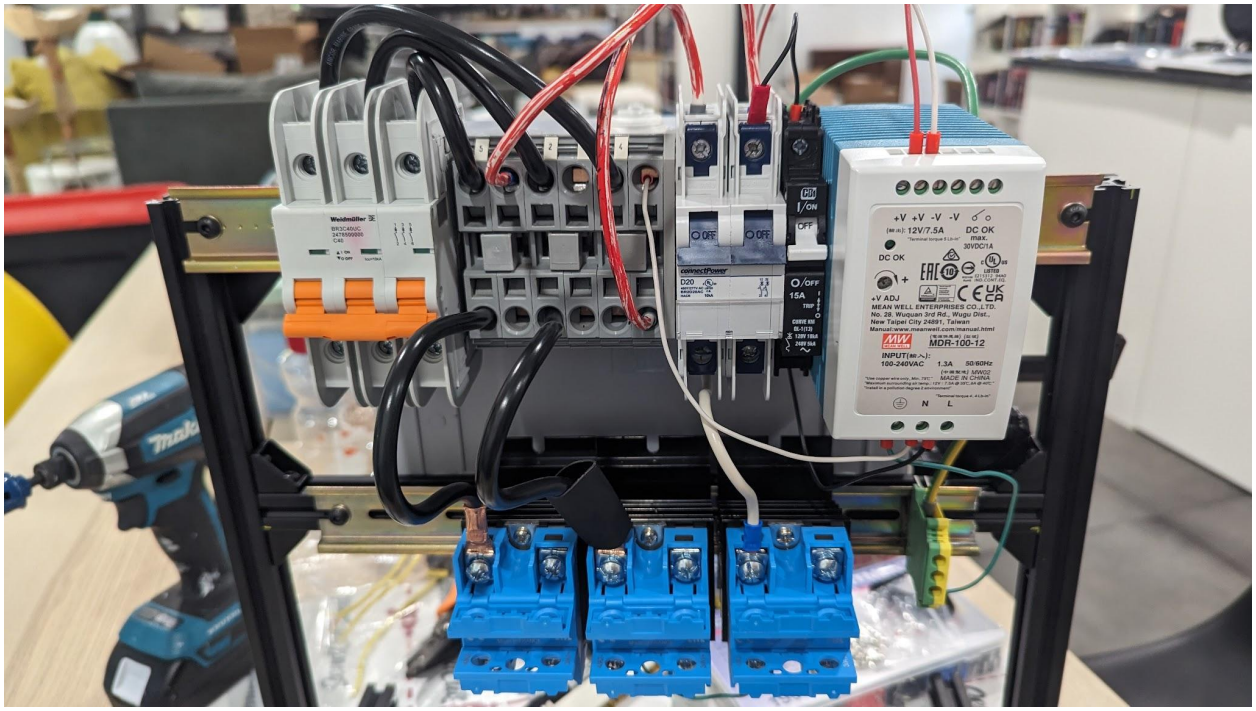
On September 25th, Lawrence Kincheloe and Rob made a long road trip from Austin through Oklahoma City to Salt Lake City. We delivered two Public Invention devices to American Oxygen, the contractor with chemical expertise building the ion transport membrane equipment.

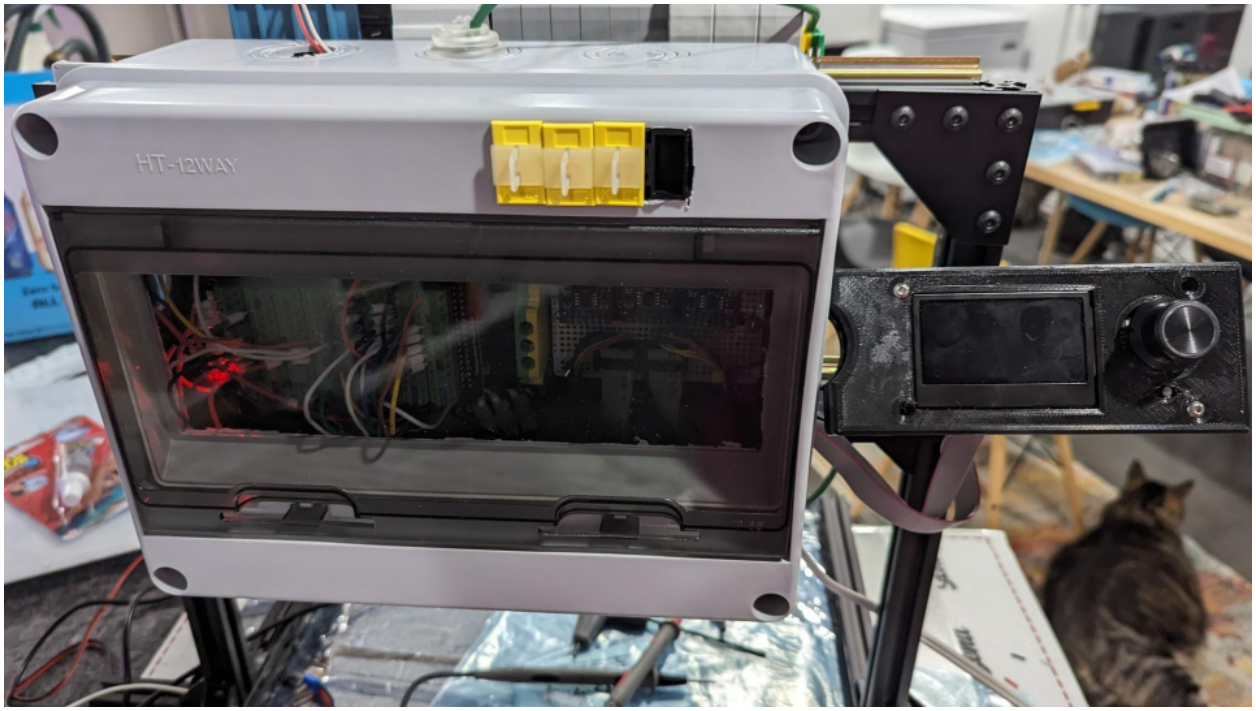
This technology has no moving parts, except for a fan to keep air moving, and extracts absolute pure O2 from the air. NASA needs this sort of thing to fill spacesuits in space without costly and unreliable electromechanical equipment such as Pressure Swing Adsorption processes followed by oxygen compressors. It could also have enormous benefits for global health, as it can be scaled down to the size of small rural clinics in low- and middle-income countries.

The first equipment we delivered controls the extraction of O2 from normal air. This is the Oxygen Engine Digital Control System (OEDCS). This is made more complicated by that fact that it needs to occur at 750C, and there is a danger of thermal runaway.



The OEDCS SN#2, delivered to NASA in September.





The second device was a control for a second stage that is first-in-the-world experiment to produce oxygen at high-pressure. If successful, this will be a game-changing inflection point.

The development effort and the trip to Utah were very strenuous. Although we have submitted an invoice for the first of five contractual “tasks”, and therefore have receivables of $50,000, we

went badly over budget and in fact have spent more than that to Lawrence, Lee Erickson, and Geoff Mulligan. Rob made a large donation to be able to pay them in a (more) timely manner.

We are modestly confident that we will not be over budget on the other tasks; a great deal of institutional knowledge has been gained in doing the first task. In particular, Public Invention now has the expertise to undertake building machines that use kilowatts of power, instead of only the small instruments which we have built in the past.

Freespireco Grant

The flagship project of Public Invention is the PolyVent Educational Platform. Along with the GPAD and the VentMon and related software, these devices form the “Free Respiration Ecosytem” or Freespireco.

Last year, we applied for the NSF POSE grant for $300,000 for Freespireco. Despite good reviews, we did not win an award. These are usually given to Universities. I consider our chances low at about 40%, but our application is better this year. We have a letter of support from NASA, and we have secured an intention from John Sullivan, previous executive director of the Free Software Foundation, to lead the project if the money is awarded.

We paid several thousand dollars to Jessica Feather, the grant writer who helped us last year, to help work through the application process, which is quite extensive. We have been asked to provide reviewers by the overseer of the NSF engineering section, which we have done.

PolyVent

The PolyVent project is now the second largest Public Invention project after the OEDCS. We are awaiting to see if we receive a grant, win a contest, or receive an orders for it. If none of these things happen, the project may have to be mothballed.

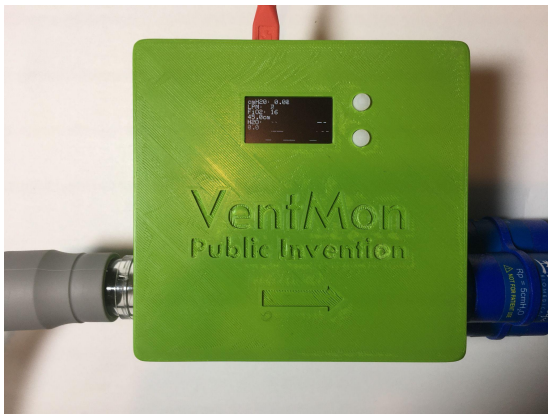
General Purpose Alarm Device (GPAD)

Lawrence mentored two teams at Oklahoma University who made great strides in adding voice and Wifi to the GPAD, though neither completed the work. Rob, Lawrence, and Lee have nearly completed a paper on the GPAD they intend to submit to the journal HardwareX. Additionally, a new volunteer, Naghram Kheir of Lebanon, will begin working on adding WiFi.

VentMon T0.5

Mr. Ben Coombs designed VentMon T0.5, and has sent me a box of 12 of them. The T0.5 is very small and a significantly improved design. Ben is going to make 13 more and send them to me. Our plan is to make a product offering of this as an IoT spirometer on our website. The

photographs below show the T0.5 (on the left) compared to the T0.4 (on the right), showing how much smaller Ben has made it.



The VentMon, the GPAD, and the PolyVent are all essential parts of the Freespireco idea—the idea of create a Free-libre respiration ecosystem of cooperating components.

Global Open Source Quality Assurance System (GOSQAS) alliance formed

In October, Pubic Invention and Open Source Medical Supplies (OSMS) led a symposium attended by about 15 thought leaders around the problem of assuring quality in rapidly manufactured emergency and medical devices based on free-libre open designs. There was broad agreement that this is a serious problem and most of the attendees agreed to create a Global Open Source Quality Assurance System (GOSQAS) alliance. Robert L. Read of Public Invention and Victoria Jaqua (board member of Public Invention and OSMS) and Christina Cole of OSMS are leading this effort.

Our initial approach is to develop a completely open provenance tracking system.

Participants in the GOSQAS alliance include:

- Public Invention
- Open Source Medical Supplies (OSMS)
- University Health Network Advanced Perioperative Imaging Lab (APIL)
- Every Breath Counts Coalition (EBCC)
- Helpful (Helpful Engineering)
- IoPA (Internet of Production Alliance)
- UBORA
- OSHWA (Open Source Hardware Alliance)

We worked with a firm to develop the software, but backed out of it due to non-performance in the initial stages. We then got very lucky in finding Mr. Harry Pierson, who did an initial prototype based on a design by Rob for $1000. We then raised $10,000 from a private donor and obligated to Harry for the completion of the design.

We now have a Minimum Viable Product, and Harry has been paid. Geoff Mulligan has expressed interest in continuing the work. Please try it!

GOSQAS is now a separate corporation, of which Rob, Christina Cole, and Victoria Jaqua are on the board. Public Invention will continue to be a fiscal sponsor for GOSQAS until it achieves its 50c3 status independently.

The MVP is going to be shown at Maker Faire Bay Area on October 22nd by Christina Cole and Rob Read. Rob is flying to San Francisco for this. We have a short speaking opportunity on stage, and will have half a booth, where we will give out stickers with QR codes for Makers to use to track the objects.

As part of the GOSQAS project, Public Invention paid $1000 for a report by Alex Barton, a regulatory expert who is make an FDA-ready maker space, to create a report on how GOSQAS satisfies the FDA market surveillance requirements.

The Global Distributed Tracking offered by GOSQAS is probably the Public Invention project with the most potential to change the world in the next two years. However, Public Invention will need GOSQAS to raise its own money in the future.

Glia Tourniquet Project

Sadly, the armed conflict in Ukraine continues. The Russian Federation seems to target civilian targets, leading to great loss of life, including of children.

Public Invention has been acting as a fiscal sponsor for GLIA, a Canadian firm that makes an open source tourniquet, which is particularly in demand in Ukraine. We have raised over $37,000 in partnership with them (included in our donations), which have already been transferred to their team. They have also given us quarterly reports in writing as we have requested.

They are now injection molding and manufacturing the tourniquets. These are high-quality tourniquets, which are tested with a device designed by graduate students of Joshua Pearce of Western University in Canada.

They function well on people with small limbs, such as women and children. The US Military is moving to having not one, but multiple tourniquets available in first aid kits, as having multiple on hand is a life-saving factor for multi-limb injuries and mass-casualties, which are all-too-common in today's conflicts.

This is completely free-and-open technology. Anyone who has a desk-top injection mold machine can start manufacturing these. However, we intend to deliver 1000 to Ukraine as originally planned. The cost and price of these is approximately $20USD.

Passive Ferrofluid Check Valve

A new volunteer, Lisa Kotowski, is now working on the passive ferrofluid check valve, attempting to perform a theoretical analysis and possibly program a simulation. She has made some progress. We would like to return to this project as time allows.

The passover ferrofluid check valve allows the creation of an air pump with no moving parts except ferrofluid. We have worked on this but have not had time to complete it.

We have a separate design for a pump for ferrofluid itself that I have high hopes for, but have not found a volunteer able to work on it, although Sid Chou is doing some manual 3D designs which may let us test the project.

The Unscrew Propeller

A new volunteer, Matthew McCartney, has been doing a computational fluid dynamics simulation of the unscrew propeller invention. Matthew is no longer in Austin, and lost the license to use his AutoCAD computational fluid dynamics program. He is now attempting to use a free alternative, OpenFOAM, which has a high-start up curve.

His works allowed us to greatly improve on my initial ideas (which were in fact erroneous.) How most recent simulations suggest it works, but are inconclusive as to effectiveness and efficiency.

A Lung Simulation of Disease Conditions

With volunteer Judith Weng, we have reconstituted a project to make lung simulations based on various disease conditions. This is written in Python and works pretty well now. We have discussed this with Dr. Erich Shultz and it is unclear if there is a demand for this. It may become a valuable part of the Freespireco project.

Financial Position

Our financial position is difficult at the moment.

We have about $45,000 in cash, about $60,000 in payables, and about $50,000 in receivables.

We went seriously overbudget on the first task. Given that we have $250,000 from NASA in the next year potentially available, we are playing a big game than we have played before.

It is entirely possible that we are paying our volunteers who are supported by NASA too much—we pay $120/hour as our top rate. However, as a non-profit I feel that we should be generous.

I am confident this will all work out—but I will also be watching it closely. If we are still overbudget in January, I will take action to curtail work or re-negotiate rates with our volunteers.

Outreach

Miriam Castillo continues to recruit volunteers. We have improved the presentation of projects at our website, although we are still updating our active projects accordingly. Miriam has learned to use Google Ads effectively for us. (Google gives non-profits $500 / month in free advertising.)

Monthly Inventor Gatherings on the Third Thursday

We have now held about 10 monthly Inventor Gatherings in a row, on the third Thursday of every month. These have been attended by between 2 and 20 people. We invite all readers of this report to register at EventBrite for it and join us for future events! This has been recognized by some as a major thought-leadership event. I believe this is slowly building momentum.

Grant Writing

We have applied for a grant from the Moody foundation in Texas for both PolyVent and GOSQAS. We have not heard back from them.

PolyVent has been submitted to the Hackaday “Save the World” contest with over $135K in prizes and a $50K first prize. This has thousands of applicants, but we have high hopes of winning some recognition at least.

Peer-reviewed Publication Submissions

Rob and Megan Cadena submitted their work “The Plane Tangent to Three Spheres Touching” to Journal of Geometry and Graphics, but it was badly rejected.

Dr. Erich Shultz, Judith Weng, and Robert L. Read have had a poster session accepted to the IEEE-EMBS 2023 International Conference on Biomedical Health and Informatics (BHI). Judith Weng will present this work. Public Invention is paying her travel costs and lodging.

Talks

Rob spoke on a panel virtually at XIX Biennial IASC (International Association for the Study of the Commons) Conference in June about GOSQAS.

Rob presented a paper on the PolyVent classroom experience entitled “A democratized open-source platform for medical device troubleshooting” to the American Society for Engineering Education in Balitmore In June. This was attend by Nathiel Bechard and Sabia Abidi, who were co-authors, along with Victor Suturin, who did not attend.

RecognizeGood

Public Invention has been named a “Lighthouse” by RecognizeGood, and will be presented a check for $1000 at the next Inventors’ Gathering, on October 18th.

Partnerships and Cooperation

As well, our work with SPEC has been particularly fruitful. The GOSQAS alliance is actively trying to improve QA across the open source world.

Rob acted as a judge at the Rice360 global design project science fair for senior capstone teams worldwide. Rob is also an active board member at Helpful Engineering, a similar 501c3.

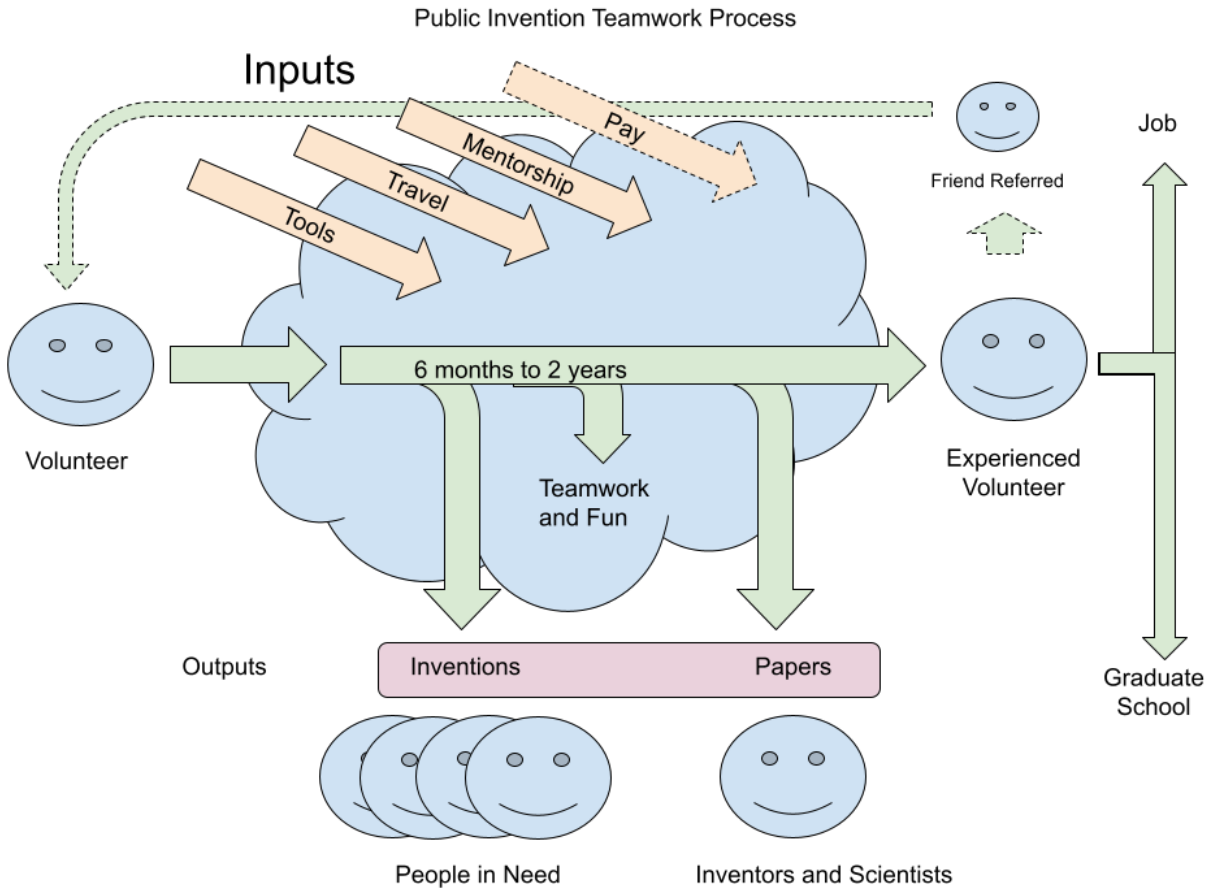
Volunteers

Nothing lasts forever. We have had some great volunteers who have finished their work or moved on. It is a major goal of Public Invention to leave every volunteer with a positive experience so that they refer new volunteers to us.

Taken as a whole our current volunteers are a strong team. They are:

1. Lawrence Kincheloe
2. Lee Erickson
3. Lisa Kotowski
4. Matthew McCartney - partial
5. Melanie Laporte
6. Nina Lahoti - partial
7. Victor Suturin
8. Antal Zuiderwijk
9. Pio Lee - left for medical school
10. Ben Coombs
11. Sid Chou
12. Judith Weng
13. Geoff Mulligan

In fact, we represent the overall process of Public Invention, in the diagram below. The three outputs of Public Invention are Inventions, Papers, and Experienced Volunteers.



Productization

Public Invention is a non-profit. Nonetheless, we believe we can have a bigger impact by doing “short-run” productions of small numbers (less than 20) units of our inventions and offering them for sale to make it easier for people to evaluate our inventions, even though all of them are completely open source.

We now intend to productize and place on sale:

- The VentMon T0.5
- The General Purpose Alarm Device (GPAD) 0.2
- The PolyVent

We plan to soon have a storefront up for this.

Strategy for the Coming Year

Much will depend on if we get the Freespireco grant or other grants in November.

A long-term goal is to raise enough money to hire an executive director so that Rob can focus on being head invention coach.

The priorities for the full year of 2023 and 2024 are:

1. Making the new NASA contract successful, which is one building block of a revolutionizing therapeutic oxygen delivery in low- and middle-income countries. - seriously underway
2. Selling five of the PolyVent Educational Platforms around the world and building a community of practice. - unlikely to be met
3. “Productizing” the GPAD 0.2.
4. “Productizing” the VentMon T0.5
5. Completing my book (currently 72 pages): https://github.com/PubInv/intro-public-invention/blob/main/intro-pubinv.pdf and finding a publisher for it.
6. Writing a technical paper for VentOS (with Dr. Schulz and Ben Coombs)
7. Writing a technical paper for the PolyVent system (with Dr. Suturin, Nathaniel, and Antal.)
8. Creating a second version of the General Purpose Alarm Device (GPAD) and productizing it.
9. Make serious research progress on the ferrofluid inventions (valve and pump).