Public Invention First (5 months) Quarterly Report, 2020

-- Robert L. Read, 5/22/2020

This is the first quarterly report of Public Invention for 2020. It is being composed in May instead of April because emergency work on the COVID-19 pandemic was prioritized.

Pre-pandemic Work

Public Invention pivoted to pandemic work on March 15th. Before that, a number of important accomplishments occurred.

- We developed and launched a professional website: https://www.pubinv.org/
- Chris Ferguson, PhD, took on the role of Invention Coach for Rapid E. coli project. He decided it was more practical to make a portable incubator than to make a new sort of chemical assay. We organized a team that has been meeting (virtually) on Monday nights. Shreya Bhatia offered a great idea: doing a stay-at-home STEM function. We are working on that; volunteer Jerry Chang and I have begun video recording for it.
- David and I had made some progress on Math Tablet.
- Along with board member Marc Jones, I presented at LibrePlanet 2020. Based on comments it was well received.
- Along with Gayatri Datar of EarthEnable and Mike Donogue, we wrote a paper and submitted it to Low-Impact Development about earthen floors. This paper was rejected.
- Approximately the same paper was resubmitted to the Engineers Without Borders USA national conference, which has now been virtualized. At the time of this writing, a decision on this paper has not been announced.
- My paper "Calculating the Segmented Helix Formed by Repetitions of Identical Subunits" was accepted to the 2nd IMA Conference on Mathematics of Robotics. This is a prelude to the publication of the journal article (which is 38 pages long.) I cut it down to 8 pages for this conference. Since I am not a mathematician, I wanted to attend a conference to learn how the mathematics social world worked. Unfortunately, this conference has now been delayed until September 8, **2021.** However, some things just take a long time. The work on segmented helices, which was a spin-off of the first Public Invention Mathathon, is now done---but publication is a huge part of the Public Invention ethos.
- With Avinash Baskaran, our robot crawled, picked up a 2 pound weight, and crawled some more. This was accomplished with the TetroCon. This has been written in a draft paper, but Avinash and I have not submitted it yet. We plan to do so, even though the tetrocon work is on hold while we prioritize the pandemic.

- With Avinash, we ordered and built some 3D printed and milled metal parts in aluminum and steel. This made it clear that I had made a mathematical error about the flexibility limits of the robot. This can be fixed---this is excellent progress--but will take some time and thought.

Post-pandemic Work

On March 15th, after the LibrePlanet conference, everything changed. We were locked down. David and I deprioritized Math Tablet until June; Avinash and I could no longer work together physically on the robot..

The COVID Vent List

I immediately created a GitHub repo to collect resources. Part of this was the creation of an shared, commentable spreadsheet that analyzed open source ventilator projects based on a rubric with Keeshan Patel and Avinash Baskaran. Enrique Perez and Avinash and I have processed over 100 github issues to update this spreadsheet as teams make progress. It now has over 100 projects on it. It has become a bit of a hit. A full page of Make Magazine (p. 33) was devoted to this Public Invention, and this video interview has been viewed 7000 times on YouTube. This spreadsheet led me to realize that the greatest contribution Public Invention could make a tester-monitor (and not another ventilator.)

The VentMon

Along with volunteers Lauria Clarke and Geoff Mulligan, Public Invention made the VentMon T0.1. This is a tester/monitor that can be used for testing proposed ventilators. We have currently shipped 4 of these for free and are attempting to make the 5th. There is a world-wide shortage a flow sensors, a problem which we are working around. The VentMon has been extremely effective in helping on team, the MillionVents team making the A.R.M.E.E. ventilator. Our goal is to continue making and giving away the VentMon to the extent that we can. We imagine the VentMon will move from being a tester to being a monitor that can be used with actual patients over time.

Grants

As part of VentMon effort, Public Invention applied for and won two separate grants of $20,000 for a total of $40,000. These grants are specifically earmarked for the VentMon effort, and allows us to manufacture and distribute the device free of charge.

Public Invention was one of the first three COVID-19 Solutions Fund Recipients by the Mozilla Open Source Solutions Fund. The second grant was from Protocol Labs. By happenstance, we have actually received the funds from Protocol Labs, but have not yet announced it so as to not conflict with the VentCon-2020 conference.

Vent-Con 2020

On May 21st, Public Invention hosted Vent-Con 2020, the first conference on open source pandemic ventilators. This was made possible by volunteer Deepti Sharma with the assistance of Avinash Baskaran and Enrique Villacres-Perez. The conference had no less than 115 attendees throughout the whole 3.5 hours. It had 15 esteemed and renowned speakers, and me. It was co-hosted by Make Magazine and HelpfulEngineering.

The Open Source Ventilator Ecosystem Model

In the Vent-Con conference, we presented the “eco-system” model of pandemic ventilators. This is based on the principles of openness, transparency, and documented standards that allow modularity. Because we are in the “pandemic mid-game”, we expect this to be a long-term effort.

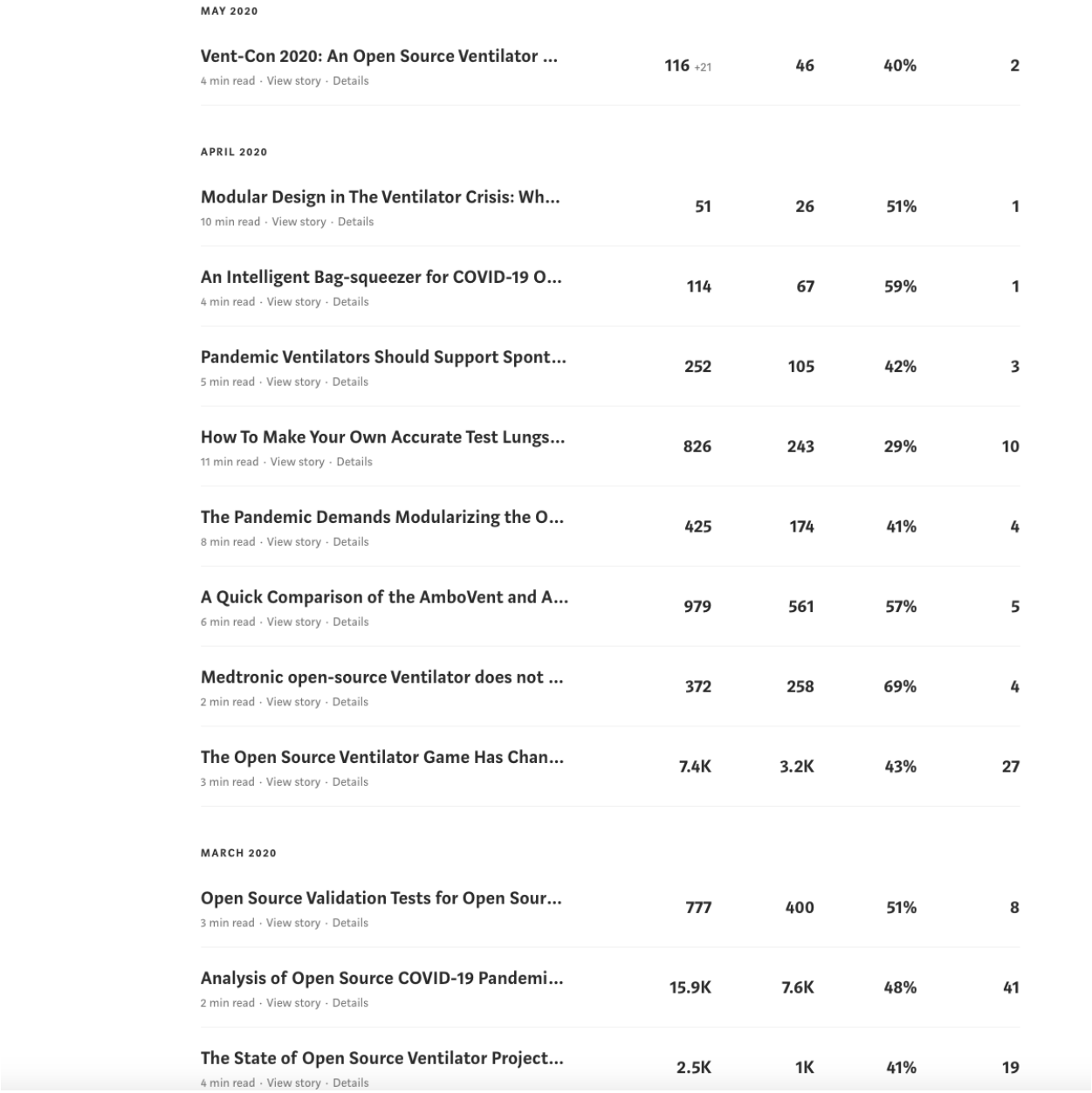
Various thought-leaders (Dale Dougherty, Karen Sandler, Nariman Poushin, myself) have been groping towards a model long-term model of open-source medical devices. This is a large task. I intend to think about how Public Invention fits into that.

Outreach and Communication Efforts

Outreach this quarter consisted of significant writings, hosting Vent-Con 2020, distributing the VentMons, and significant person communications with leaders in Brazil, Kenya, Israel, and Germany, as well as leaders of various consortia and organizations here in the US.

Writings

The pandemic required a great deal of communication; I have written more than usual. These writings in this period all mention Public Invention. The have been viewed approximately 30K times:



MAY 2020				
Vent-Con 2020: An Open Source Ventilator ... 4 min read · View story · Details	116 +21	46	40%	2
APRIL 2020				
Modular Design in The Ventilator Crisis: Wh... 10 min read · View story · Details	51	26	51%	1
An Intelligent Bag-squeezer for COVID-19 O... 4 min read · View story · Details	114	67	59%	1
Pandemic Ventilators Should Support Spont... 5 min read · View story · Details	252	105	42%	3
How To Make Your Own Accurate Test Lungs... 11 min read · View story · Details	826	243	29%	10
The Pandemic Demands Modularizing the O... 8 min read · View story · Details	425	174	41%	4
A Quick Comparison of the AmboVent and A... 6 min read · View story · Details	979	561	57%	5
Medtronic open-source Ventilator does not ... 2 min read · View story · Details	372	258	69%	4
The Open Source Ventilator Game Has Chan... 3 min read · View story · Details	7.4K	3.2K	43%	27
MARCH 2020				
Open Source Validation Tests for Open Sour... 3 min read · View story · Details	777	400	51%	8
Analysis of Open Source COVID-19 Pandemi... 2 min read · View story · Details	15.9K	7.6K	48%	41
The State of Open Source Ventilator Project... 4 min read · View story · Details	2.5K	1K	41%	19

For your reading pleasure, these are:

1. https://medium.com/@RobertLeeRead/vent-con-2020-an-open-source-ventilator-conference-19879c53cca4

2. https://medium.com/@RobertLeeRead/modular-design-in-the-ventilator-crisis-why-it-matters-ff767c420b70 (with Jenny Filipetti)
3. https://medium.com/@RobertLeeRead/an-intelligent-bag-squeezer-for-covid-19-open-source-ventilators-and-why-it-matters-6585ec2843ed
4. https://medium.com/@RobertLeeRead/pandemic-ventilators-should-support-spontaneous-breathing-77d991f2e11d (with Dr. Erich Schulz)
5. https://medium.com/@RobertLeeRead/how-to-make-your-own-accurate-test-lungs-for-testing-emergency-ventilators-2d68fe5ac460 (with Alex Izvorski)
6. https://medium.com/@RobertLeeRead/the-pandemic-demands-modularizing-the-open-source-ventilator-problem-b20bc41e66ff (with Nariman Poushin)
7. https://medium.com/@RobertLeeRead/a-quick-comparison-of-the-ambovent-and-apollo-bvm-pandemic-ventilators-977d15345440
8. https://medium.com/@RobertLeeRead/medtronic-open-source-ventilator-does-not-meet-uks-rapidly-manufactured-ventilator-systems-81947c72a7ac
9. https://medium.com/@RobertLeeRead/the-open-source-ventilator-game-has-changed-ambovent-and-medtronic-covid-19-ventilators-open-d645bde594cc
10. https://medium.com/@RobertLeeRead/open-source-validation-tests-for-open-source-covid-19-emergency-ventilators-7096c6393d61
11. https://medium.com/@RobertLeeRead/analysis-of-open-source-covid-19-pandemic-ventilator-projects-27acf9075f7e
12. https://medium.com/@RobertLeeRead/the-state-of-open-source-ventilator-projects-as-of-march-21st-1f36bfb608b4

Public Invention

Status of Last Quarter's Goals

- Organize the Invention Projects into a map and other forms that make them easier to understand. *Partially accomplished by the work that Stephanie and Rob did on the "short list". Done*
- Identify and promote the top 3 projects (probably Rapid E. Coli detection, the Tetrobot, and the Segmented Helix project.) *Done*
- Plan a Public Invention event in conjunction with some other organization.Done--Rob and Marc submitted to LibrePlanet, and hosted Vent-Con 2020 with Make Magazine and HelpfulEngineering.
- Improve our web presence, perhaps by hiring a web designer - *Done*
- Progress Math Tablet to the point of being able to announce and possibly attract new recruits - progress, probably needs one more quarter, and pandemic has derailed for now
- Identify and promote the top projects with a coherent strategy - done

- Develop a fundraising strategy partial (grants were successful, strategy is incomplete.)
- Build a better website and web presence - done
- Establish a “shop” for selling swag and merchandise - failed
- Create more recruiting efforts - partial (excellent new volunteers recruited)
- Continue working on Number Spectra project - failed, project abandoned

Goals retained from Previous Quarter

- Hold a successful workshop/retreat - failed
- Build a functional hand-held “gluss controller” puppet that controls the main tetrobot to the level of an impressive demo and video. Part of this goal is to have a paper/publication/website which can assist Avinash in applying to graduate school. Done (publication required.)
- Significantly begin a carbon-reduction project, possibly an internal combustion wood-burning stove failed, derailed by pandemic

Financials

This quarter, we received about $1200 from Ian Smith, two $50 donations over the web, and most importantly, $40,000 in grants. Approximately $6000 has been spent on equipment for the VentMon project. We have increased our purchase of services such as Zoom to host the conference and other meetings. We have approximate $24,000 in the bank, with an additional $20,000 in receivables.

Completed Projects

- The segmented helix project was successfully completed with acceptance of a capstone academic paper.
- The SoftRobotMath project has been mothballed due to the pandemic.
- The NumberSpectra project is abandoned.

Active Projects

- The TetroCon project made tremendous progress, which was halted like a runaway train hitting a mountainside when the pandemic struck. Because this is a physical device, it is

not easy for Avinash and I to collaborate on this, and he is no longer in Austin. However, the project is not dead---merely in stasis.
- The Tetrobot was making excellent progress, but has been paused.
- The VentMon project is white-hot.
- The Rapid E. coli project is making progress in the presence of difficult circumstances thanks to Chris Ferguson and Jerry Chan.

Closing Thoughts

A number of very positive things have happened for Public Invention:

- Chris Ferguson becoming an invention coach (along with David Jeschke) is a very important growth step.
- Successfully receiving grants means that we are clearly a public charity with broad community support (and not a private foundation of the founder.)
- Successfully hosting Vent-Con 2020 has placed Public Invention at the center of the open-source pandemic ventilator movement.
- The COVID-19 pandemic has derailed a number of projects due to our intentional re-prioritization. I don't think anyone will think that is a bad decision; we are addressing the most urgent health crisis of our generation.