

Poseidon Quick Facts:

Operation: infuse & withdraw
Total Cost: <\$400
Print time: 23hr
Build time: 30min
Syringe: BD Plastic 1-60mL
Dist Units: mm, mL, μ L
Time units: sec, min, hr
Pos. Tol: \pm 2%
Pos. Range: 0-150mm
Speed Range: 60 μ m-60 mm/min
Max Rate: 33.24 mL/min
Min Rate: 1.03 μ L/min
Microscope: excellent

Experiments are easy:

Assuming components are connected and powered:

1. Launch the GUI by typing
`python gui.py`
2. Load `testing.txt` by
pressing `File -> Load Settings`
3. Select the arduino port
4. Send the settings to the controller by pressing `send to controller`
5. In the run tab, enable the pumps you want to run, and enter their displacements
6. Press `run` on the run tab to start your experiment
7. Pause or stop at any time by pressing `pause` or `stop`

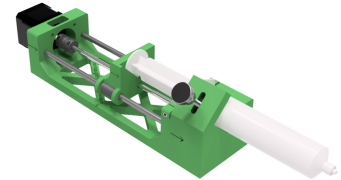
Get started:

Check out the project page which has all of the files as well as detailed instructions on how to build (and hack) the system! <https://pachterlab.github.io/poseidon/>

An overview of the Poseidon System

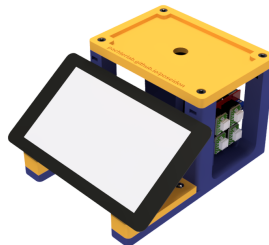
THE Poseidon pumps and microscope are a customizable open source alternative to commercial systems that costs less than \$400 and can be assembled in under an hour. It uses 3D printed parts and common components that can be easily purchased from Amazon or other retailers. The microscope and pumps can be used together in microfluidics experiments, but the pumps can also be connected to a computer and used independently for other experiments.

The pumps are driven by an Arduino with a CNC shield and up to three pumps can be run at once. Each pump has a stepper motor that drives a lead screw which in turn moves a sled that is mounted on linear bearings. The displacement of the sled moves the syringe forward or backward allowing the user to dispel or intake liquid.



The controller station uses a Raspberry Pi with a touchscreen to connect to the Arduino and microscope via USB. Because the microscope and Arduino use USB connections, they can alternatively be connected to any computer instead.

On the development of the Poseidon System



The Poseidon system was designed to be customizable. It uses the Raspberry Pi and Arduino electronics boards, which are supported by a strong ecosystem of open source hardware and software, facilitating the implementation of new functionalities. The following components developed for the Poseidon system are made available:

1. Computer Aided Design (CAD) files of the 3D printed components
2. Pump controller software and Graphical User Interface (GUI) to control the Arduino
3. Arduino firmware used to drive the motors

The 3D printed components can be fabricated on any desktop fused filament fabrication (FFF) 3D printer. They were designed using Autodesk Fusion 360, a proprietary CAD software that offers free academic licenses. To modify the 3D models the user can either use Fusion 360 or any other CAD software.

The GUI was created using Qt designer, a drag and drop application for organizing buttons that allows the user to easily make modifications. This GUI is used to interface with a Python script that controls both the microscope and Arduino via USB.

The pumps are driven by an Arduino board that interprets commands sent via USB and sends the proper signal to control the stepper motor movement. The user can take advantage of this by developing custom movement patterns using built-in Arduino functions.

On the licensing of the Poseidon System

This is still TBD.

User Quotes

Finally a reliable, inexpensive, and hackable system that I can use for my Drop Seq experiments.

— J. Gehring (Post Doc)

I loved how easy the system was to setup!

— L. Pachter (P.I.)

The system comes really close to beating out the Harvard Pumps, I can't wait to work on these pumps and contribute to the open source community.

— E. D. V. Beltrame (Graduate Student)

Tech Specs

Motor Type: Nema 17

Motor Steps: 200/rev

Screw pitch: 0.8 mm/rev

Microstep: $1/2$ $1/8$ $1/16$ $1/32$

Dist per step: 4 μ m

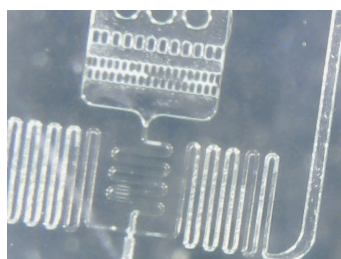
Arduino Power: 12V DC @ 2A

Raspi Power: 5V DC @ 1A

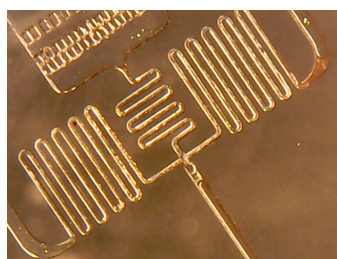
Contact Us:

Sina Booesagh
Pachter Lab, California Institute
of Technology Pasadena, CA.
aboeshab@caltech.edu
pachterlab.github.io/poseidon

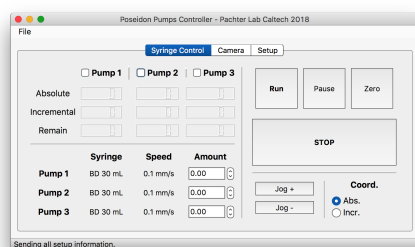
Appendix A: Images of the Poseidon system



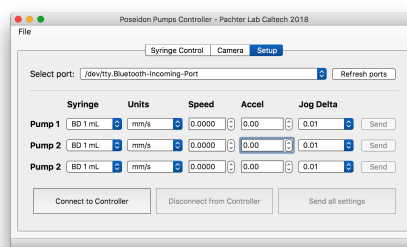
(a) USB Microscope w/ LED



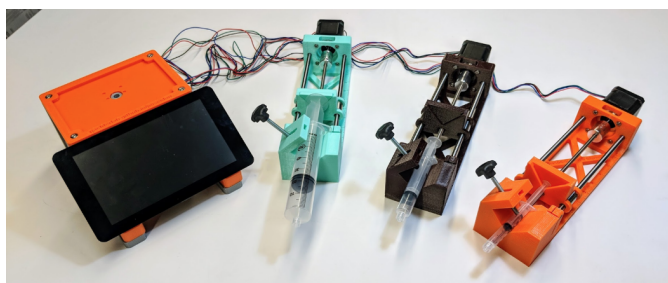
(b) USB Microscope w/o LED



(c) GUI run page



(d) GUI settings page



(e) The whole system