

# A case for Open Science Hardware



**Berlin Open Science Meetup | Feb 06, 2019**  
[meetup.com/Berlin-Open-Science-Meetup/events/258563559/](https://meetup.com/Berlin-Open-Science-Meetup/events/258563559/)

Jo Havemann – Access 2 Perspectives



# What is Open Source/Science Hardware (OSH) ?

physical components of technology based  
on an open-design

free and open-source software (FOSS)  
combined with open-source hardware

applied to a scientific context

# Why

# Open Source/Science Hardware (OSH)

# ?

the current supply chain for science hardware limits access and impedes creativity and customisation

sharing open designs, which often take advantage of modern digital fabrication techniques (e.g. 3D printing)

increase access to experimental tools

ease customisation of experimental setups

reuse and adapt hardware components while lowering costs

# Gathering for Open Science Hardware

[openhardware.science](http://openhardware.science)



**Jenny Molloy**  
Co-organiser  
Gathering for Open Science  
Hardware



[openmta.org](http://openmta.org)



[openplant.org](http://openplant.org)



AFRICA  
OPEN SCIENCE  
HARDWARE

[africaosh.com](http://africaosh.com)

Funding and support:



# Gathering for Open Science Hardware

Making Open Science Hardware ubiquitous by 2025



[openhardware.science/global-open-science-hardware-roadmap/](https://openhardware.science/global-open-science-hardware-roadmap/)

# GOSH Manifesto

[English](#) | [Español](#) | [Français](#) | [Português](#) | [中文](#) | [বাংলা](#) | [日本語](#)

The Global Open Science Hardware (GOSH) movement seeks to reduce barriers between diverse creators and users of scientific tools to support the pursuit and growth of knowledge. These are our principles:

- ▼ **GOSH is accessible**
- ▼ **GOSH makes science better**
- ▼ **GOSH is ethical**
- ▼ **GOSH changes the culture of science**
- ▼ **GOSH democratizes science**
- ▼ **GOSH has no high priests**
- ▼ **GOSH empowers people**
- ▼ **GOSH has no black boxes**
- ▼ **GOSH is impactful tools**
- ▼ **GOSH allows multiple futures for science**



# Teaching and Research in Natural Sciences for Development in Africa

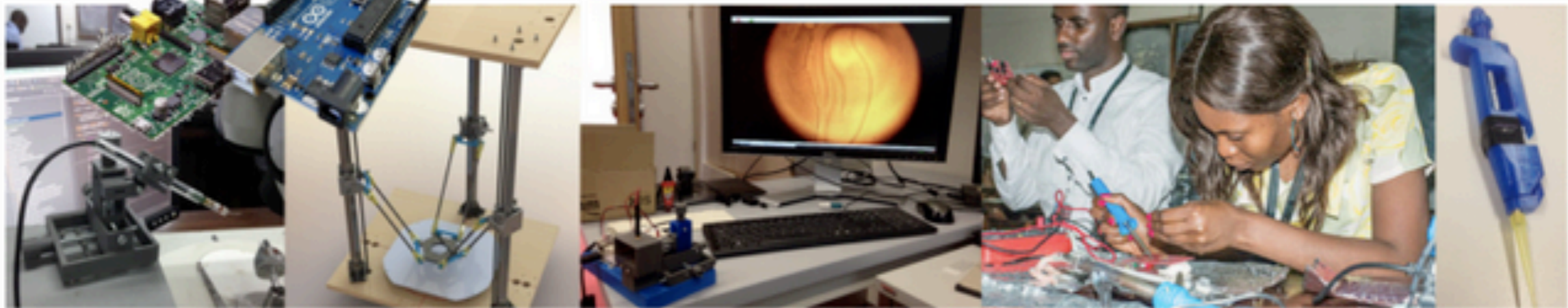


## 1<sup>st</sup> Advanced Open Labware workshop

### Build your own lab equipment

April 16<sup>th</sup>- 28<sup>th</sup> 2018

University of Cape Town, South Africa



Application Deadline 14<sup>th</sup> Feb. 2018. Apply at [bit.ly/2D69RNf](http://bit.ly/2D69RNf) or [www.TReNDinAfrica.org](http://www.TReNDinAfrica.org)

**Eligibility:** We only accept group applications from African countries or Germany. A group consists of three (3) members, all of whom should be based at the same or nearby University of research Institution. Each individual candidate may only feature in one group application. MSc to Prof. eligible.

**Description:** Groups should apply with a project idea to build a piece of lab/research/science equipment of their choice. During the workshop they will design, assemble, test and document their machine and hone it towards an academic pre-print and/or a project GitHub. Note: This is an advanced course, so at least some previous experience with DIY or Open Labware is desirable.

We will cover return plane tickets from a major airport in your country to Cape Town, accommodation for the full 2 weeks including breakfast and lunch. Visa costs and other meals are not covered.



[trendinafrica.org](http://trendinafrica.org)



**Ofori Charles Antipem**  
[thescienceset.com](http://thescienceset.com)  
[dext.tech](http://dext.tech)





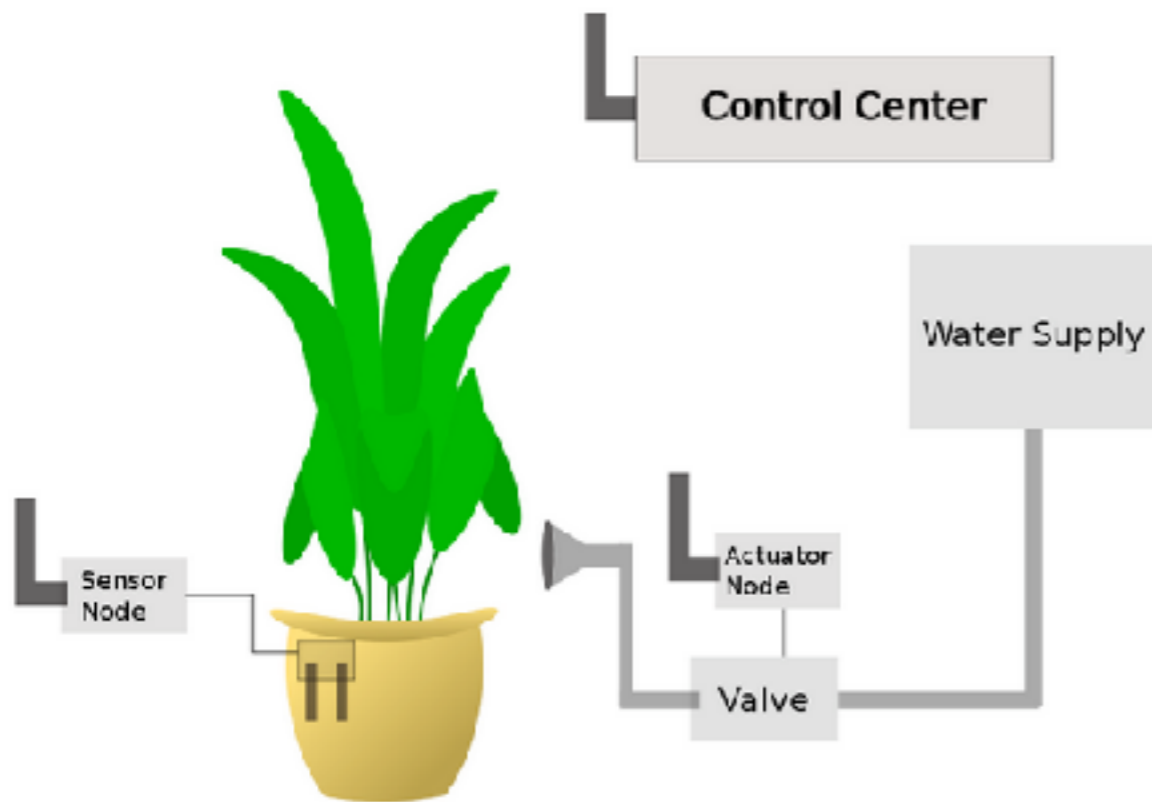


# Aravinth Panch

aravinth.info

github.com/AravinthPanch

## Smart Green House



[github.com/AravinthPanch/smart-green-house](https://github.com/AravinthPanch/smart-green-house)



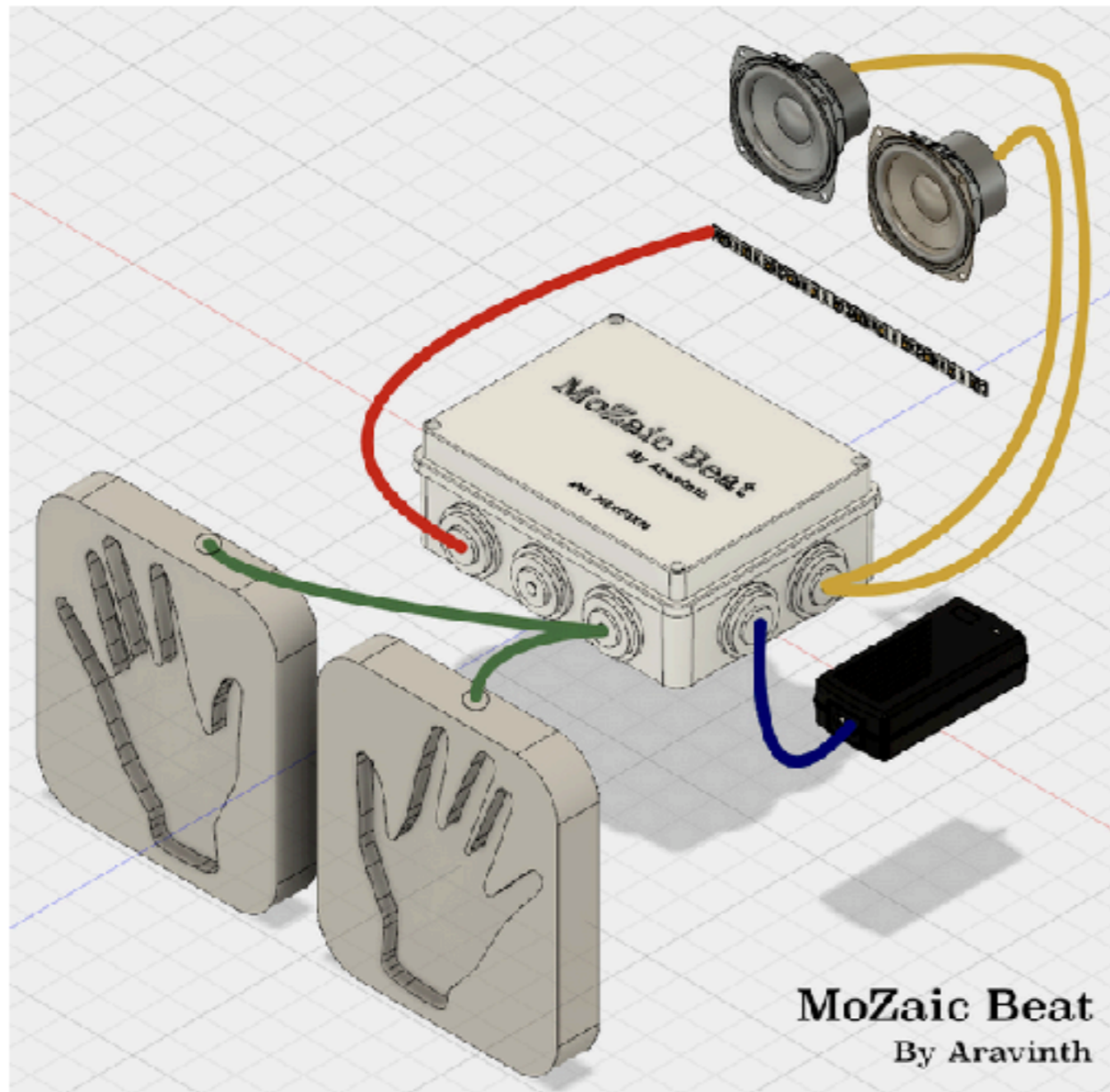
[github.com/AravinthPanch/macsexperts](https://github.com/AravinthPanch/macsexperts)  
macsexperts.com



# Aravinth Panch

[aravinth.info](http://aravinth.info)

[github.com/AravinthPanch](https://github.com/AravinthPanch)



**André Maia Chagas**  
github.com/amchagas  
github.com/FOSH-following-demand



# Haves and have nots must find a better way: The case for open scientific hardware

André Maia Chagas

Version 2 Published: September 27, 2018 • <https://doi.org/10.1371/journal.pbio.3000014>

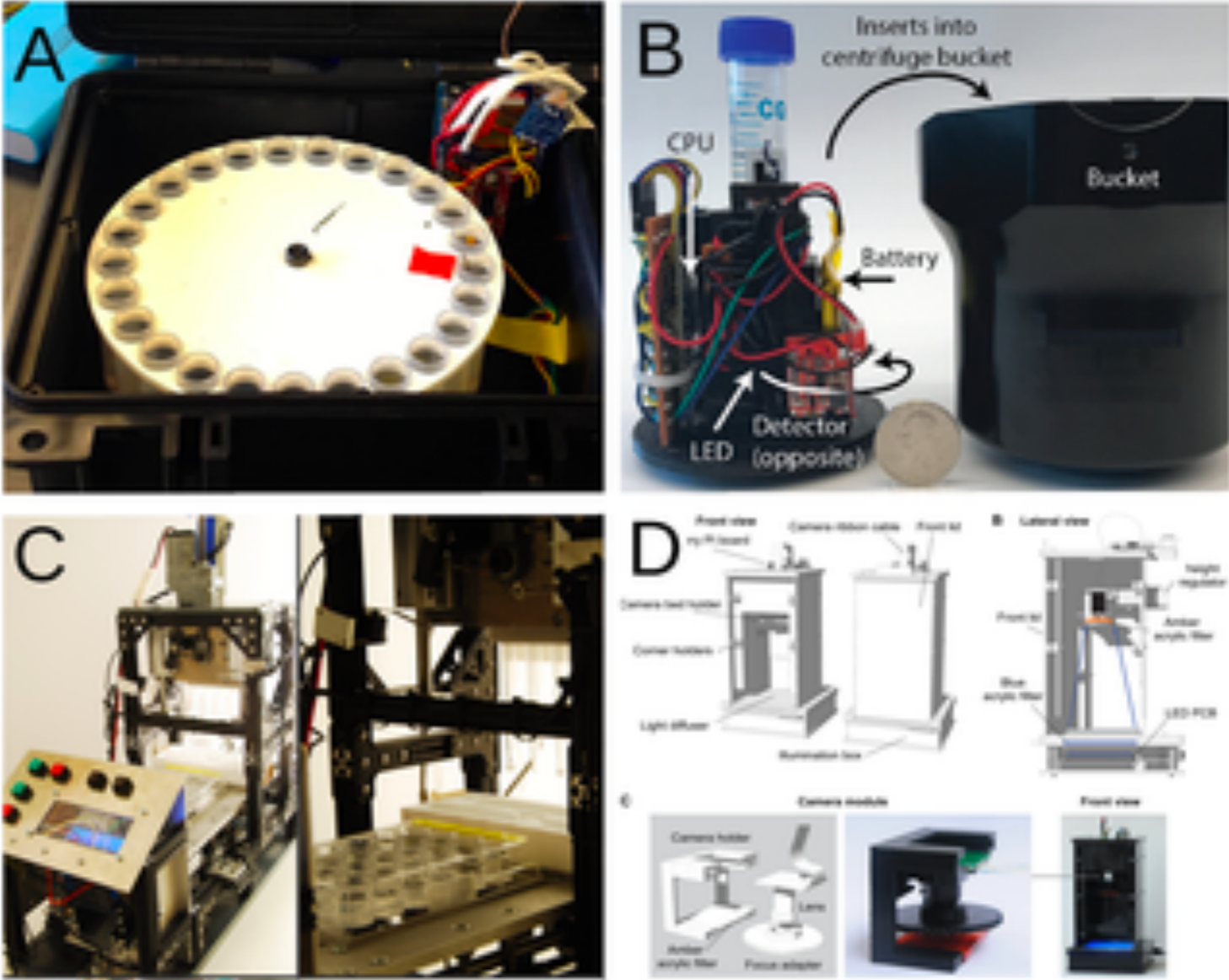


Fig 1. Open source hardware for research and education.  
DOI: 10.5281/zenodo.2564076

**André Maia Chagas**  
github.com/amchagas  
github.com/FOSH-following-demand



# The €100 lab: A 3D-printable open-source platform for fluorescence microscopy, optogenetics, and accurate temperature control during behaviour of zebrafish, *Drosophila*, and *Caenorhabditis elegans*

Andre Maia Chagas , Lucia L. Prieto-Godino, Aristides B. Arrenberg, Tom Baden 

Published: July 18, 2017 • <https://doi.org/10.1371/journal.pbio.2002702>

Fig 6. Thermogenetics.

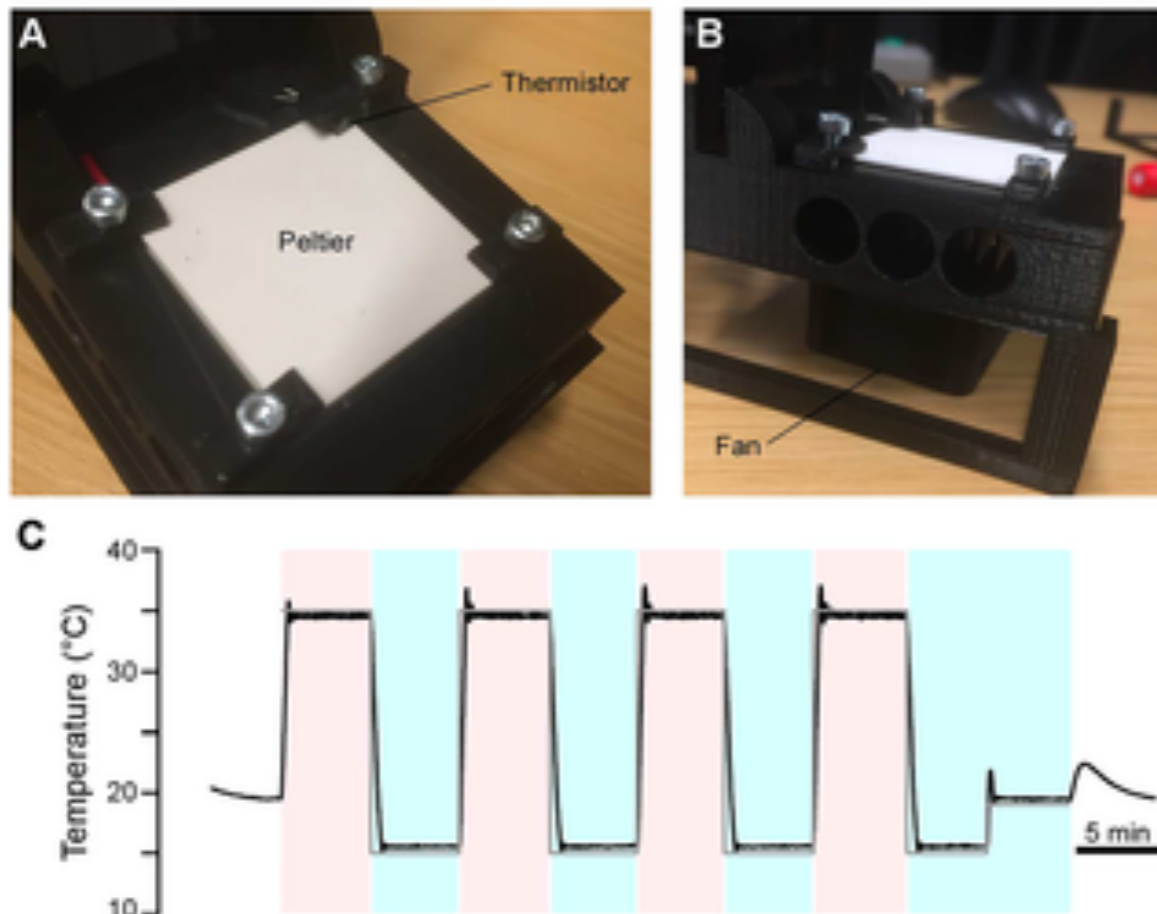
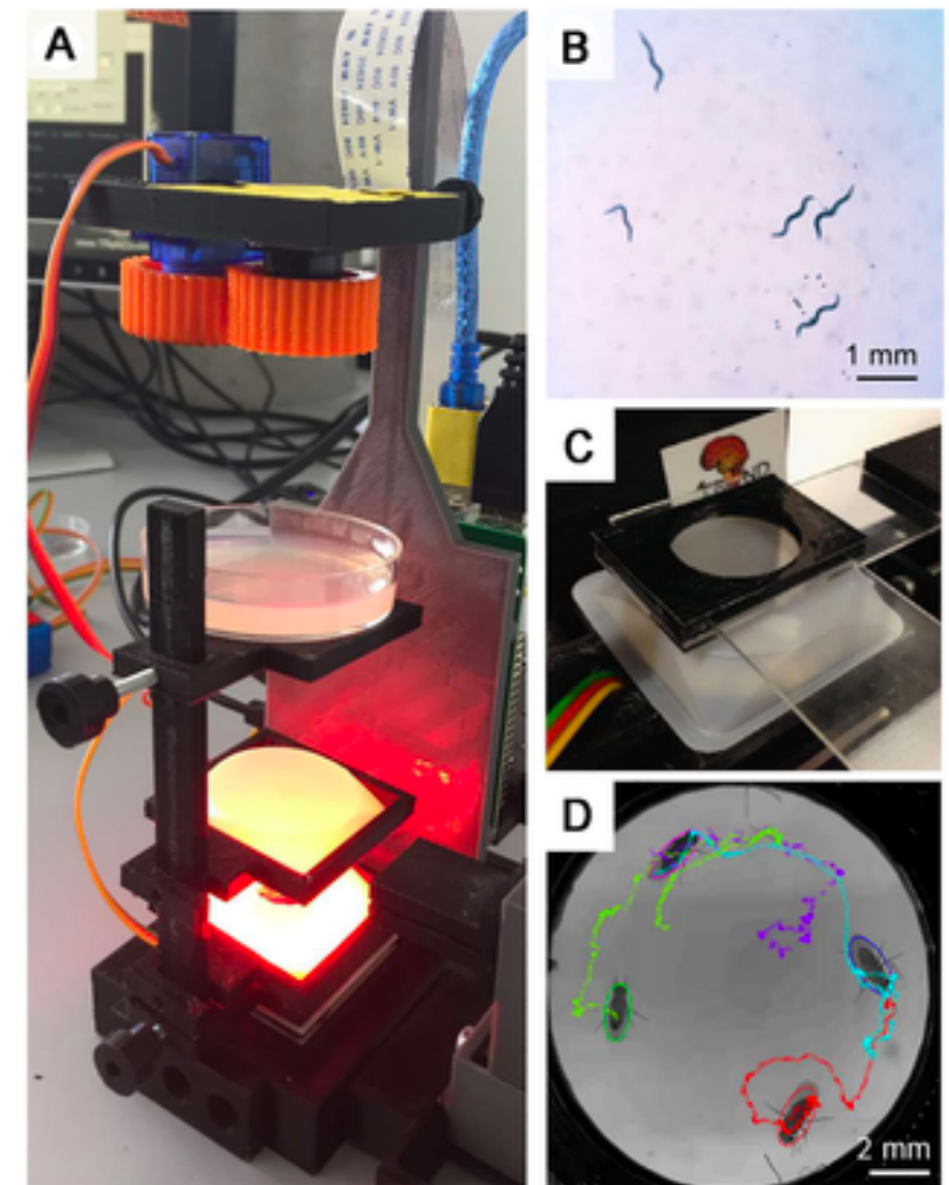


Fig 4. Behavioural tracking.



**André Maia Chagas**

github.com/amchagas

github.com/FOSH-following-demand



## Building FOSH following demand

Language: English

Change the language

# Build free and open source scientific equipment following demand

This survey was developed as a collaboration between: Rede de Pesquisadores, OpenNeuroscience, Prometheus Science, Trend in Africa, and the Mozilla Foundation.

Our goal is to identify what are the current demands and needs related to scientific equipment used by researchers/DIYers/curious people in their projects.

Your participation will enable us to develop a series of online tutorials related to building affordable equipment. It will also help us identify opportunities for the creation of equipment distributed under open/permissive licenses. Under these types of licenses, the created equipment can be used, modified, copied, and improved for new use cases.

[fosh-following-demand.github.io/en/survey](https://fosh-following-demand.github.io/en/survey)

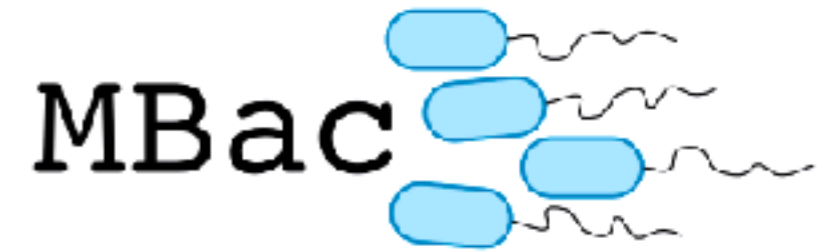


**Alexander Kutschera**

[github.com/vektorious](https://github.com/vektorious)

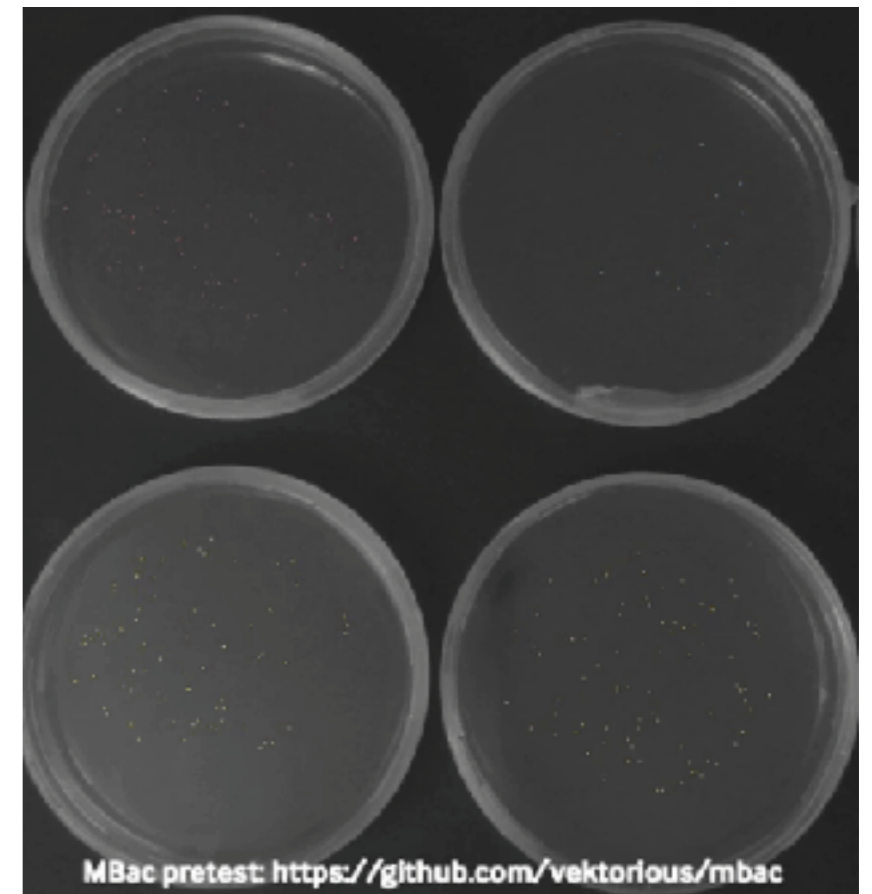
[github.com/vektorious/lightM](https://github.com/vektorious/lightM)

[openplant.science](https://openplant.science)



3D-printing  
+ simple electronics  
+ computer vision  
+ machine learning

= online monitoring for  
macroscopic movements of bacteria



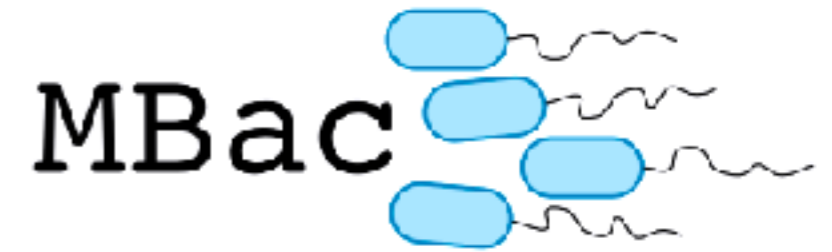


**Alexander Kutschera**

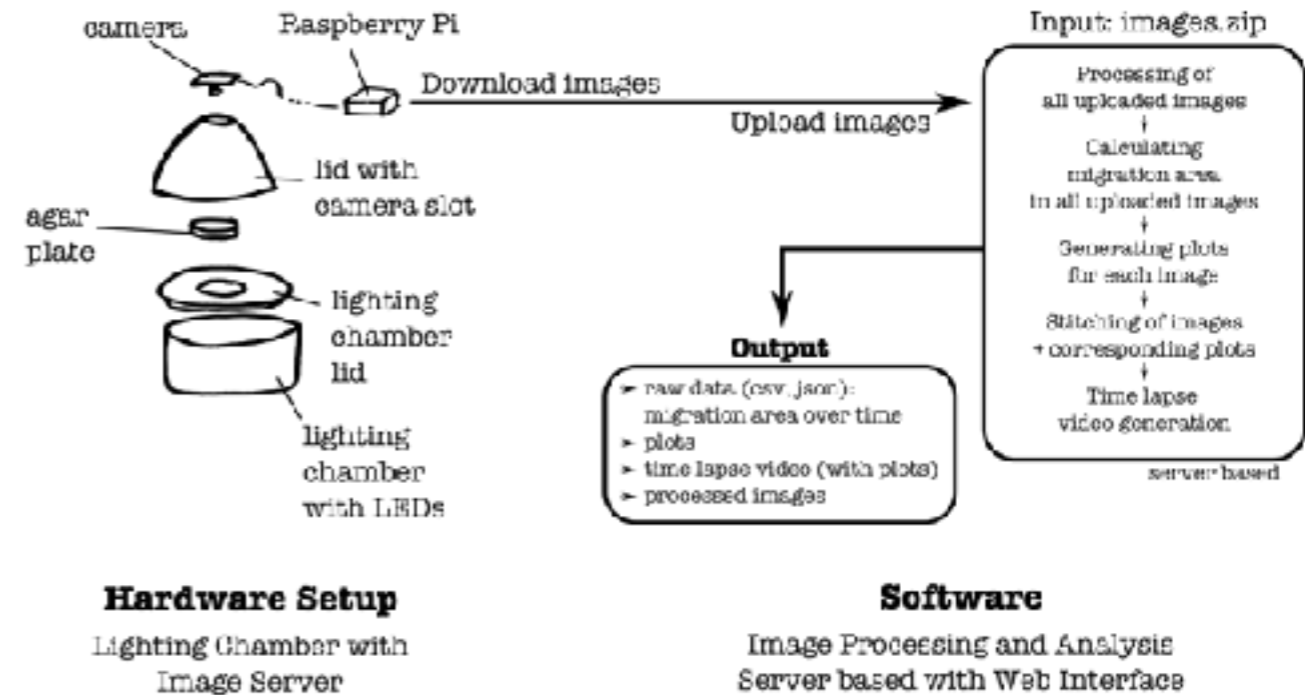
[github.com/vektorious](https://github.com/vektorious)

[github.com/vektorious/lightM](https://github.com/vektorious/lightM)

[openplant.science](https://openplant.science)



MBac Setup



3D-printing  
 + simple electronics  
 + computer vision  
 + machine learning

= online monitoring for  
 macroscopic movements of bacteria

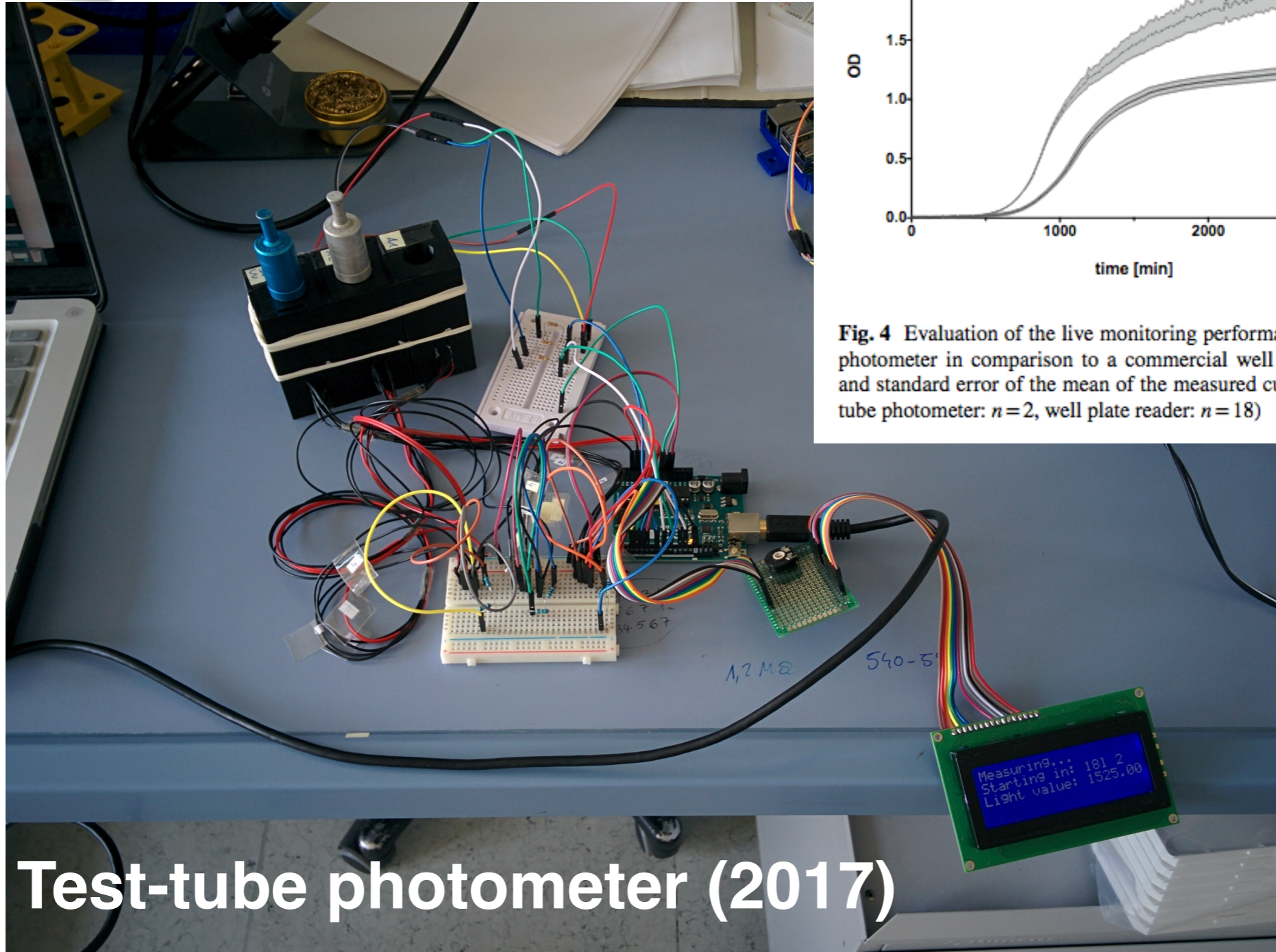


# Alexander Kutschera

[github.com/vektorious](https://github.com/vektorious)

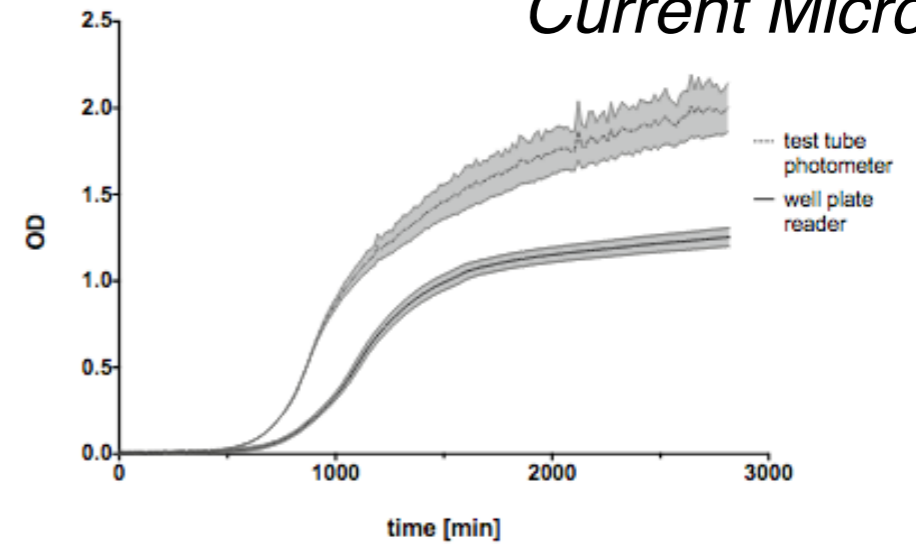
[github.com/vektorious/lightM](https://github.com/vektorious/lightM)

[openplant.science](https://openplant.science)



## Test-tube photometer (2017)

## Kutschera and Lamb (2018) *Current Microbiology*



**Fig. 4** Evaluation of the live monitoring performance of the modular photometer in comparison to a commercial well plate reader. Mean and standard error of the mean of the measured culture densities (test tube photometer:  $n = 2$ , well plate reader:  $n = 18$ )





**Alexander Kutschera**

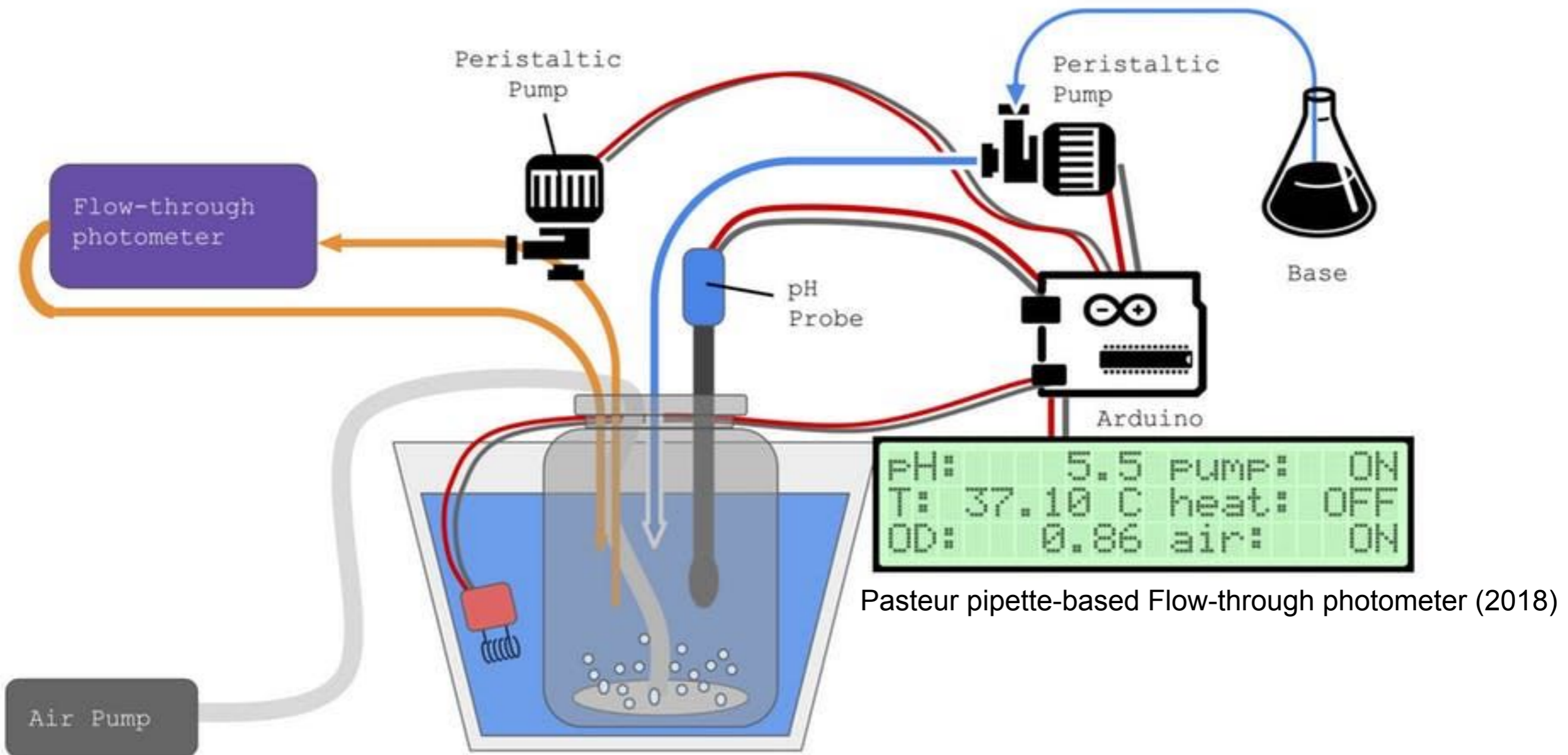
[github.com/vektorious](https://github.com/vektorious)

[github.com/vektorious/lightM](https://github.com/vektorious/lightM)

[openplant.science](https://openplant.science)

# Microbial Bioreactor

An open microbial bioreactor for growing cultures of about 1L.





[africaosh.com](http://africaosh.com)



**AfricaOSH 2019**

Dar es Salaam

Tanzania



[africaosh.com](http://africaosh.com)

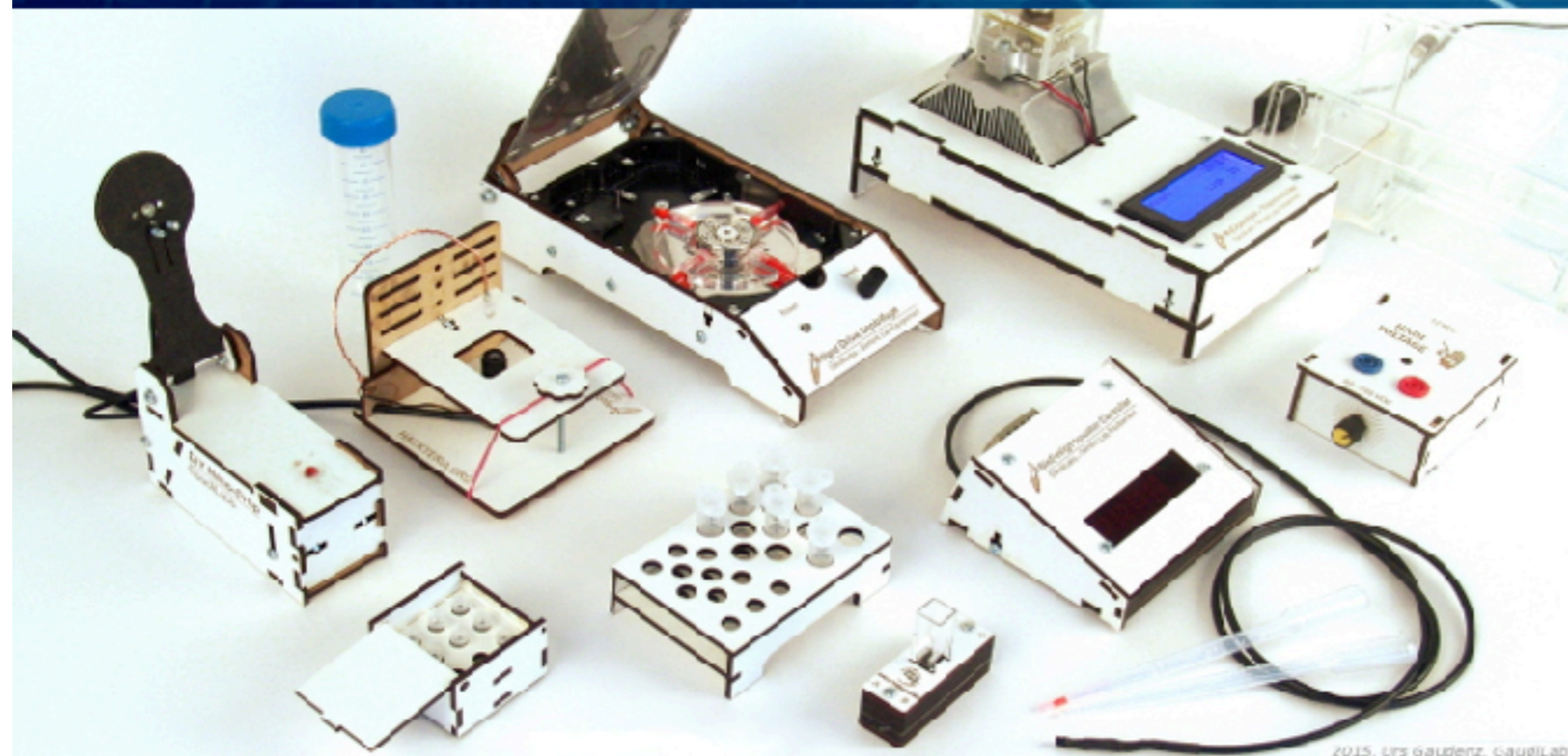


# THE DIGITAL NATURALISM CONFERENCE

Field Biology | Interaction Design | Wild Hacking

# DINACON 2019





2015, Urs Gaudenz, Caudillabs

## LATEST ARTICLES

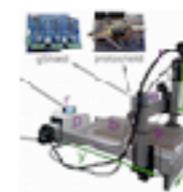
## POPULAR ARTICLES



**Sustainable Innovation for Open Hardware and Open Science - Lessons from The Hardware Hacker**

Hsing — 10 Sep 2018

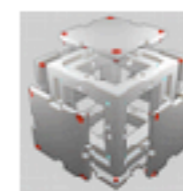
Share: [f](#) [t](#) [g+](#) [in](#)



**A Cartesian Coordinate Robot for Dispensing Fruit Fly Food**

Wayland & Landgraf — 31 Jul 2018

Share: [f](#) [t](#) [g+](#) [in](#)



**μCube: A Framework for 3D Printable Optomechanics**

Delmans & Haseloff — 16 May 2018

Share: [f](#) [t](#) [g+](#) [in](#)



**Development of an Extruder for Open Source 3D Bioprinting**

Banović & Vihar — 30 Jan 2018

Share: [f](#) [t](#) [g+](#) [in](#)

[Follow on Twitter](#)

## About this Journal

The international peer-reviewed *Journal of Open Hardware* publishes papers and reviews on technical, legal, economic, and sociocultural aspects of open hardware design, fabrication, and distribution. Its primary goal is to promote research and development of professional, academic, and community-based open hardware projects.

# Innovation Hubs, Hacker- & Makerspaces in the world

Crowdsourced Atlas of Community Innovation Spaces



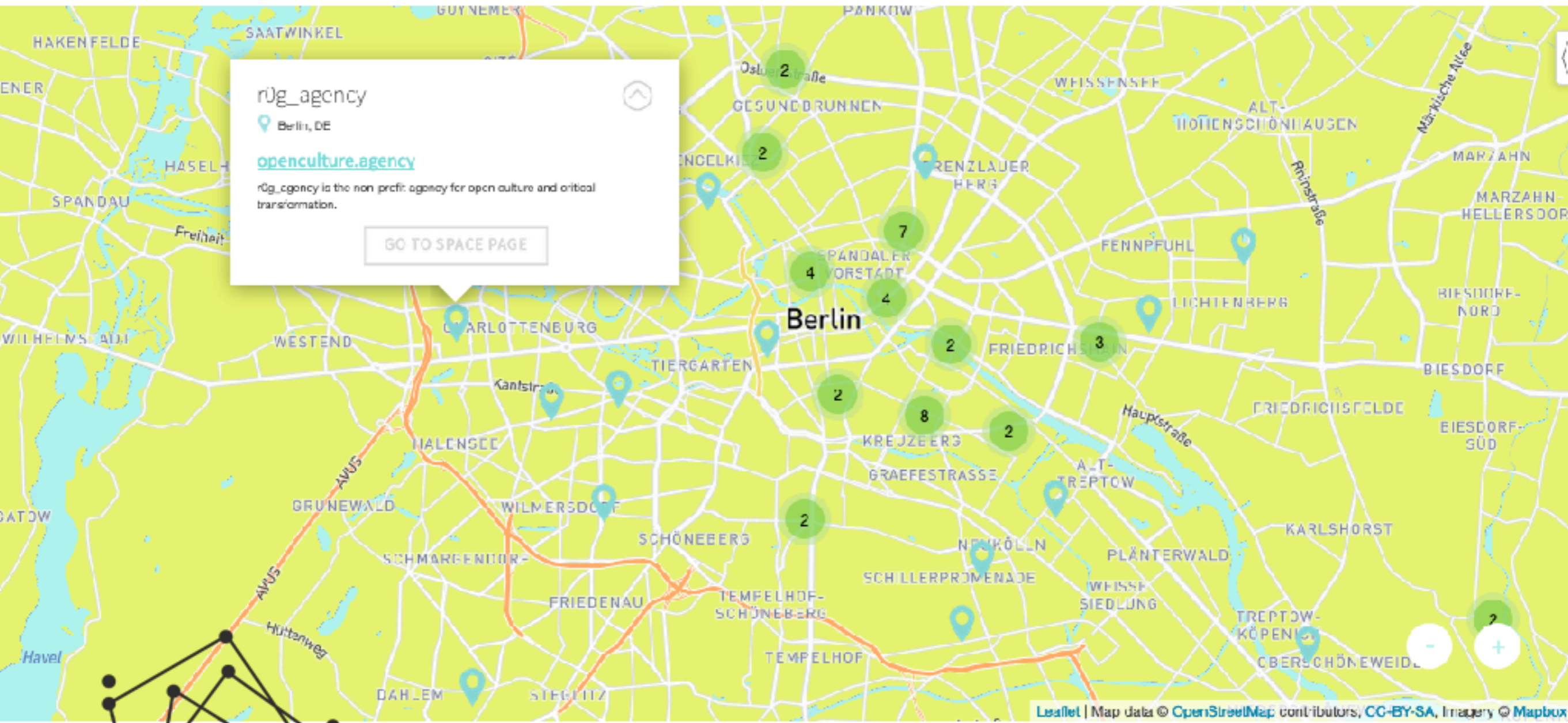
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox



[atlasofinnovation.com/map/](https://atlasofinnovation.com/map/)

# Innovation Hubs, Hacker- & Makerspaces in Berlin

## Crowdsourced Atlas of Community Innovation Spaces

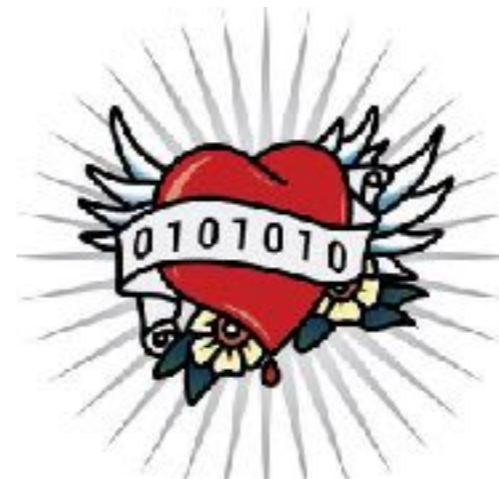


[atlasofinnovation.com/map/](https://atlasofinnovation.com/map/)

# Innovation Hubs, Hacker- & Makerspaces in Berlin



AfRA Berlin



Heart of Code



Berlin





Science Hack Day Berlin



[meetup.com/Berlin-Science-Hacking/](https://www.meetup.com/Berlin-Science-Hacking/)

[berlin.sciencehackday.org](https://berlin.sciencehackday.org)

DOI: 10.5281/zenodo.2564076



## Access 2 Perspectives

Online Communication, Science & International Affairs



[access2perspectives.com](https://access2perspectives.com)



@johave