echopen

Medical Imaging Device - open and collaborative project

Project presentation

2019

FONDATION PIERRE FABRE

SANOFI ESPOIR FOUNDATION

altran .Foundation for Innovation

ASSISTANCE PUBLIQUE HÔPITAUX DE PARIS

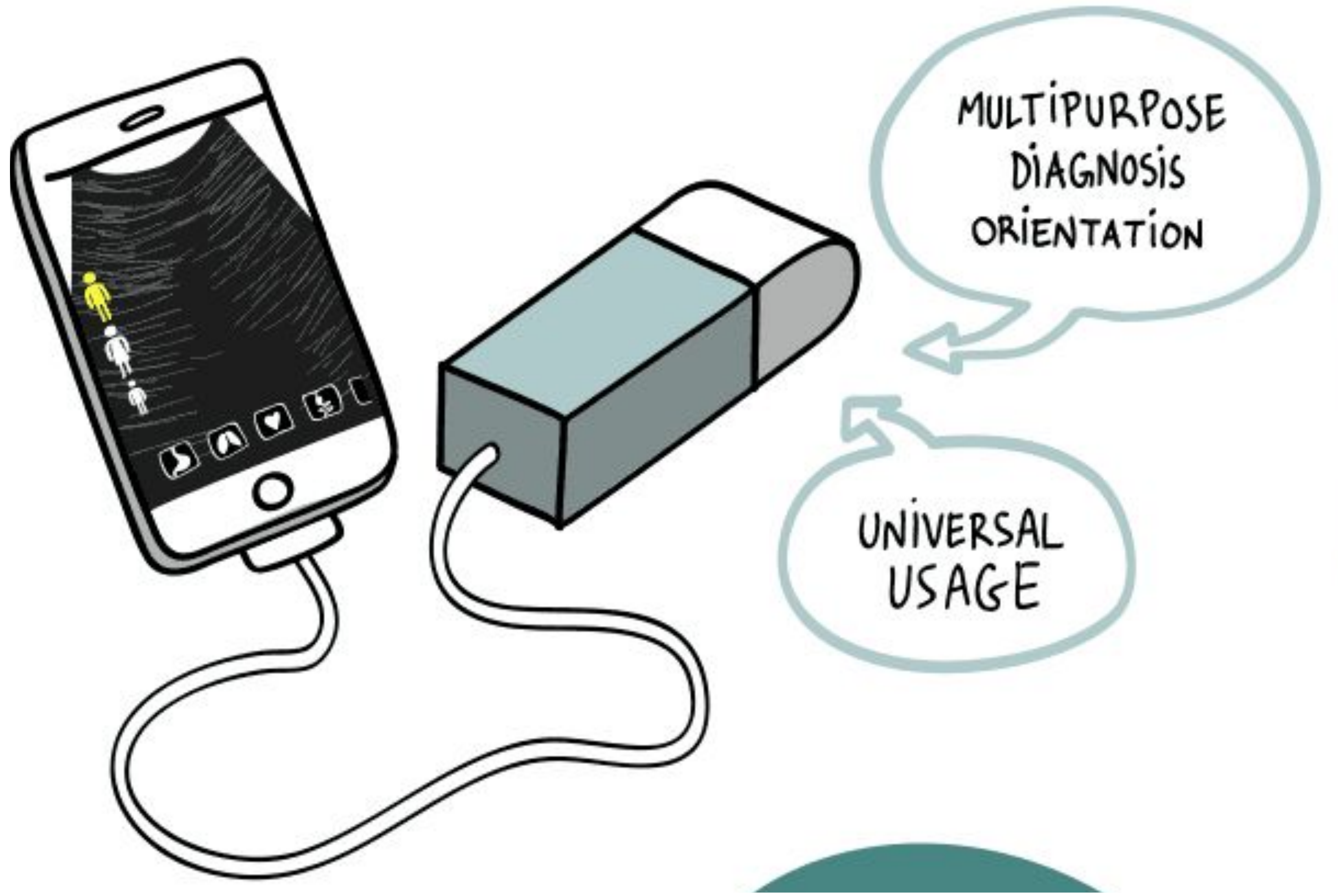
Medical Imaging Access

- **2/3 of the world population** don't have access to diagnostic imaging
- **Up to 70%** of medical imaging equipment in Africa is never used, due to infra-structural issues, irrelevant application and lack of staff training

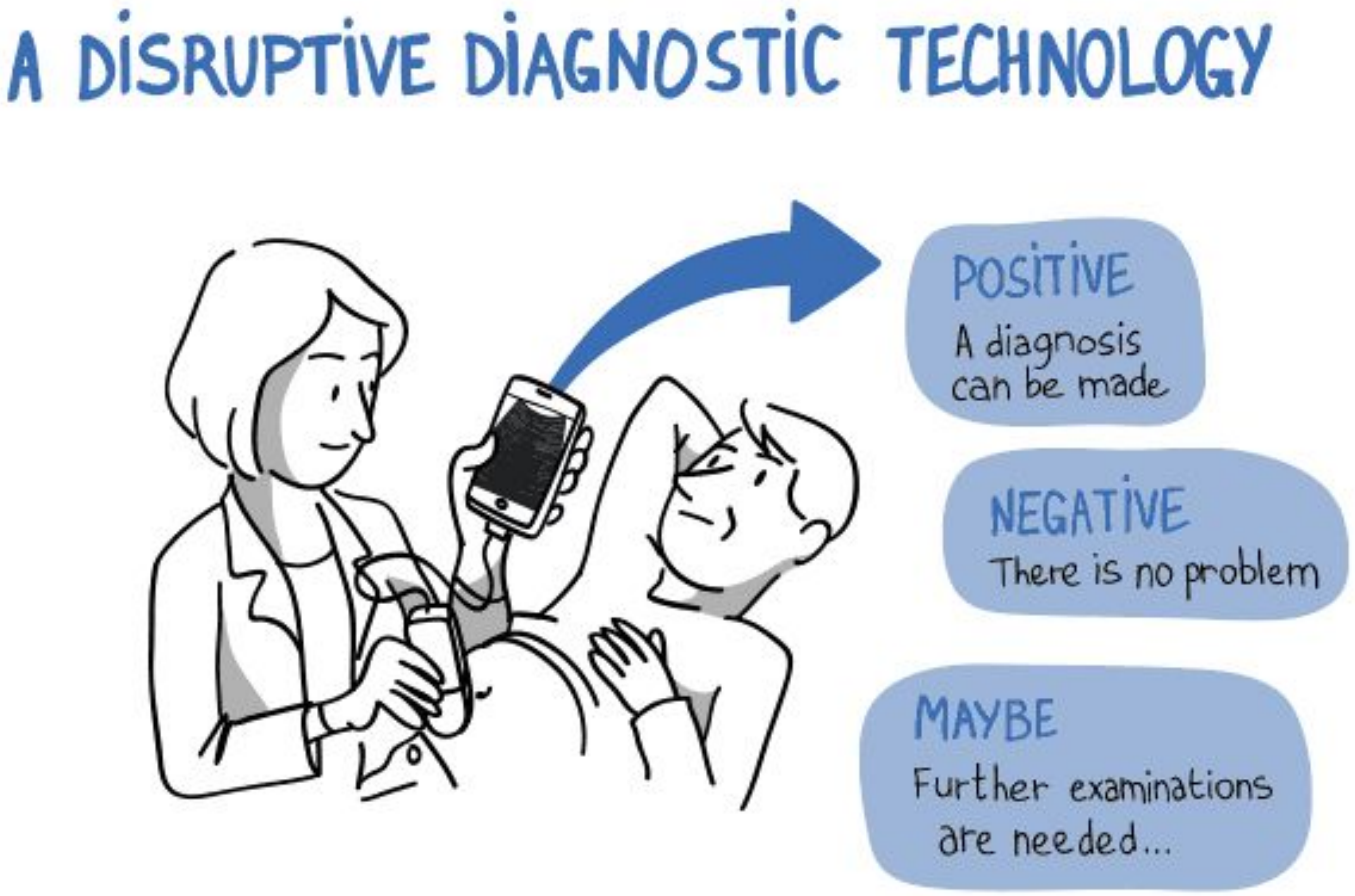
source : WHO

Aim

Designing a **universal**, **open source** and **affordable** medical echo-stethoscope (ultrasound probe) **connected** to a mobile device (smartphone) for diagnostic orientation



Purpose



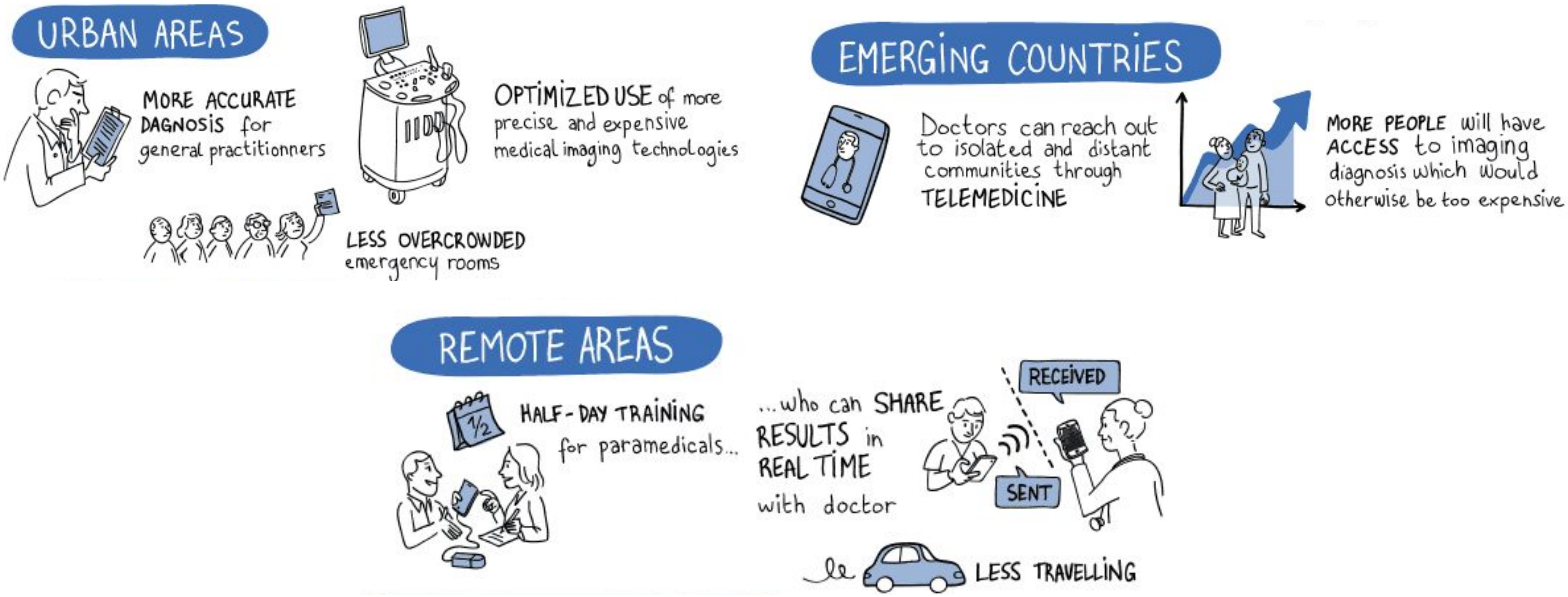
Allowing the radical **transformation** of **diagnostic orientation** in

- hospitals,
- general medicine
- and medically underserved areas

in both southern and northern countries

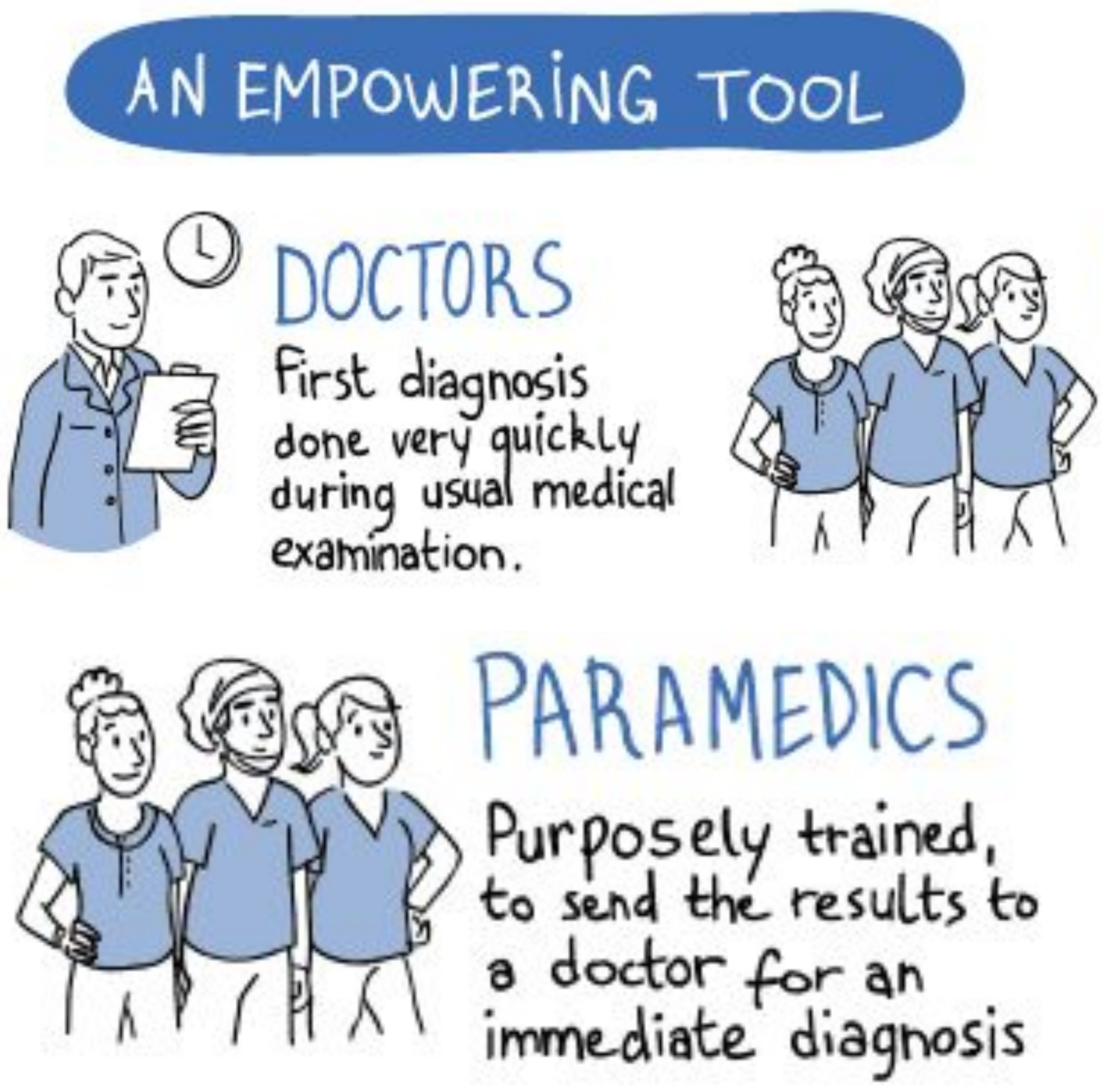
Impact

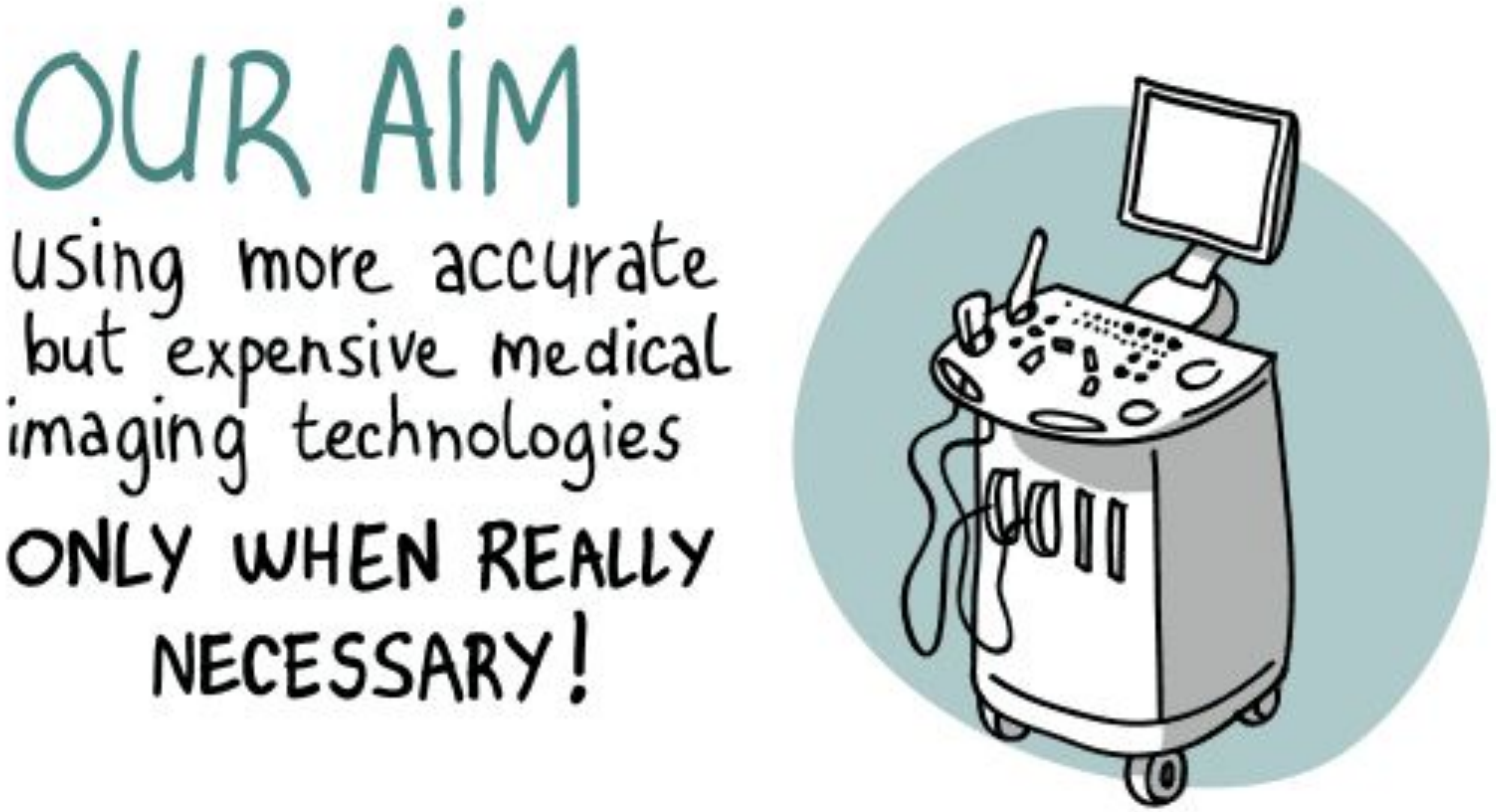
Better Access To Medical Imaging Anytime, anywhere, any moment



Beneficiary

Faster Diagnosis And Cost Reduction



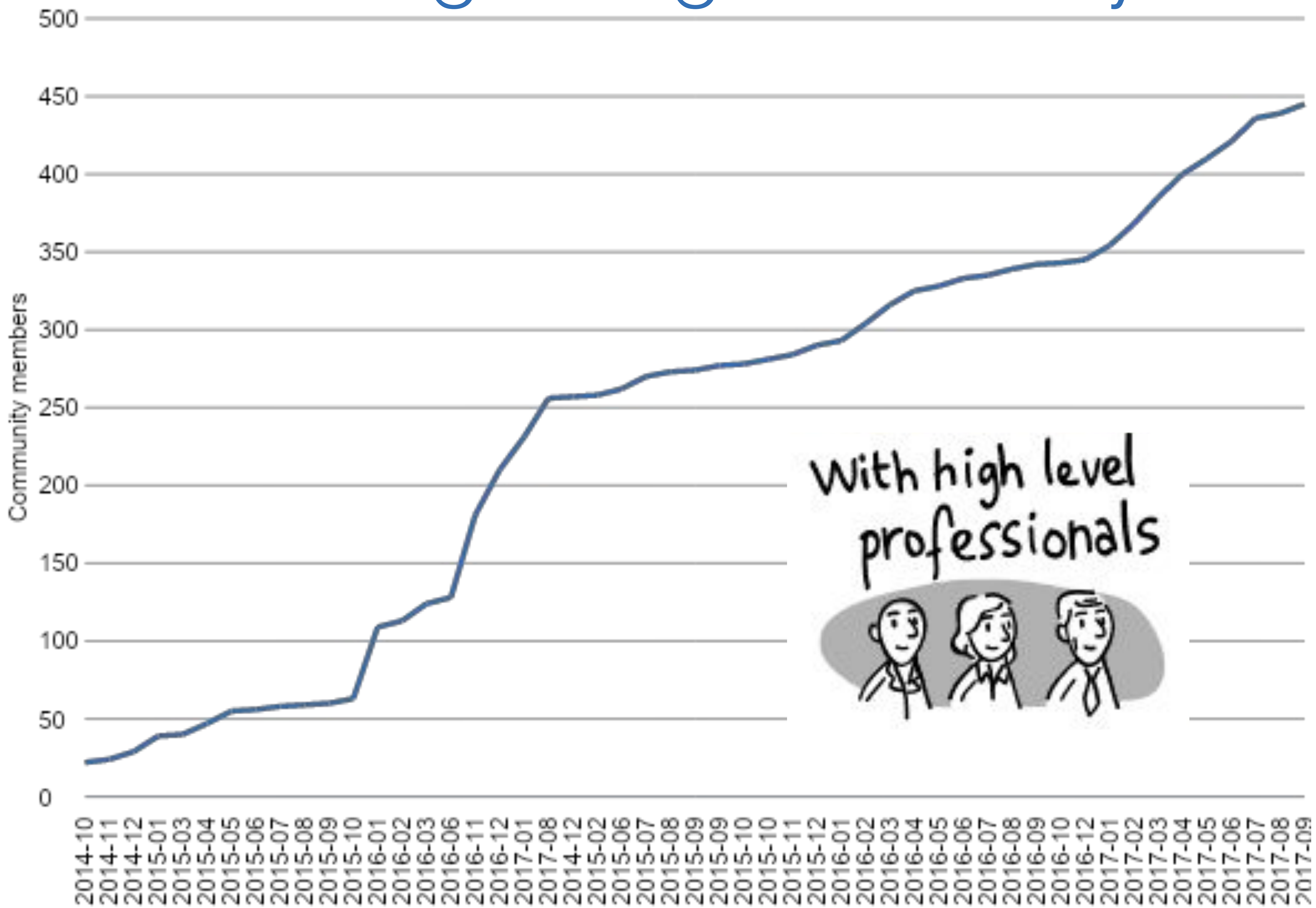


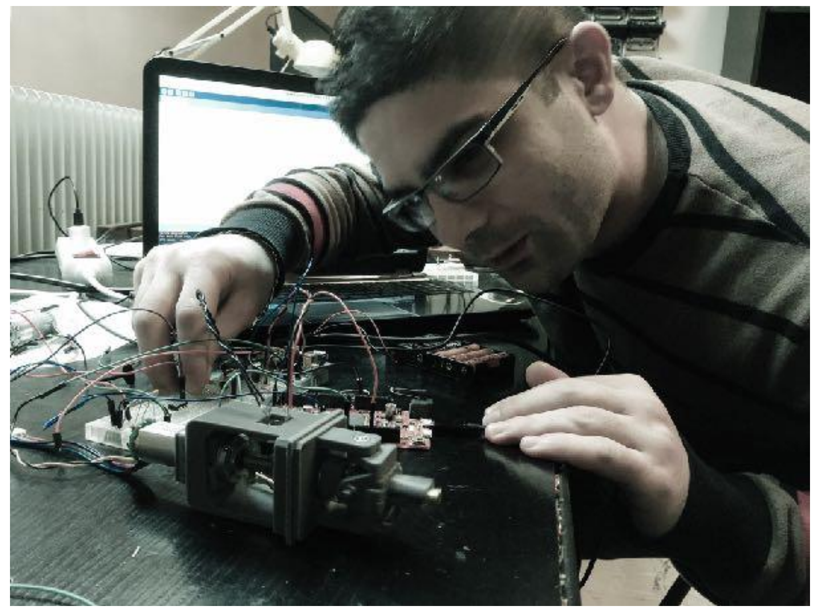
Story

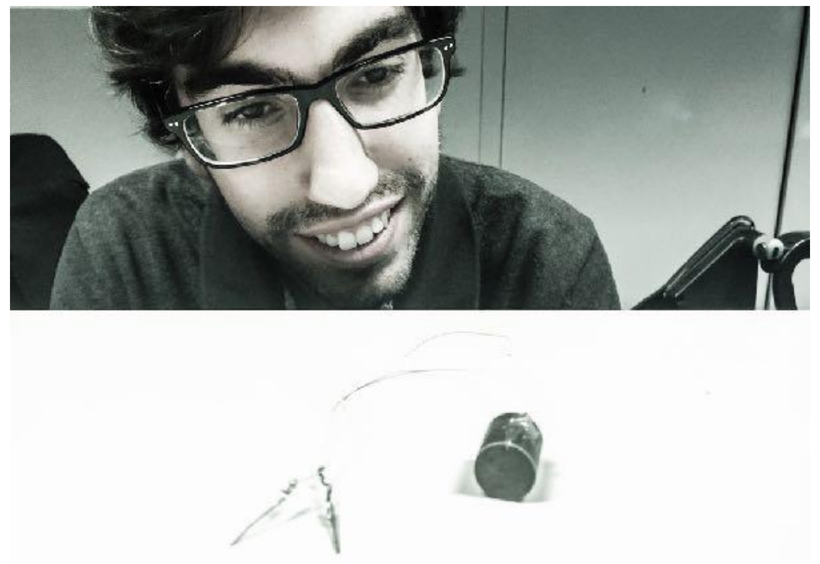
Everything started with a CHALLENGE
to democratize the access to quality healthcare.
ultra portable
remote diagnosis
opensource software
quick diagnosis results
opensource hardware
low cost
?
1
2
3
4
5
2014 AUTUMN
the idea took shape
2015 SPRING
Pierre Fabre Foundation started supporting EchOpen
2015 AUGUST
Hotel Dieu Hospital hosted the project
2015 DECEMBER
our community reached 200 members
2016 FEBRUARY
very first prototype

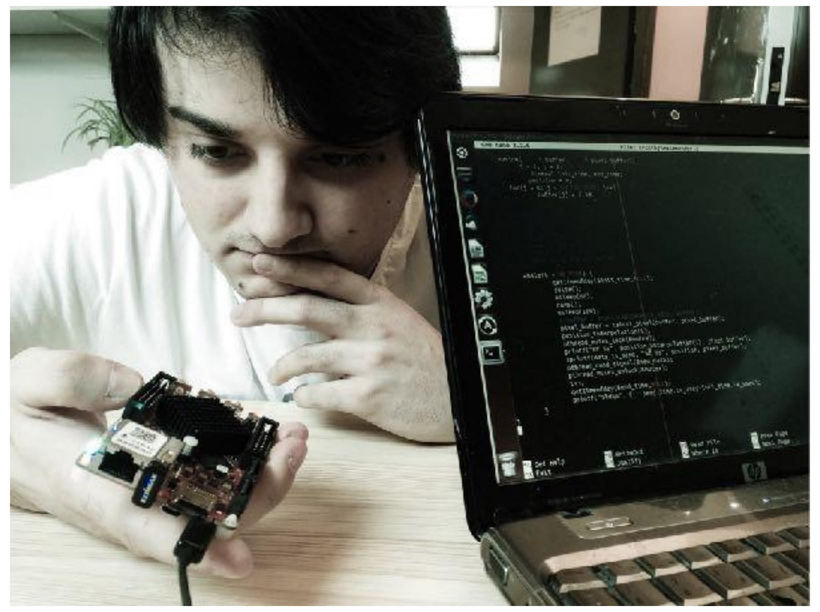
Community

Fast growing community





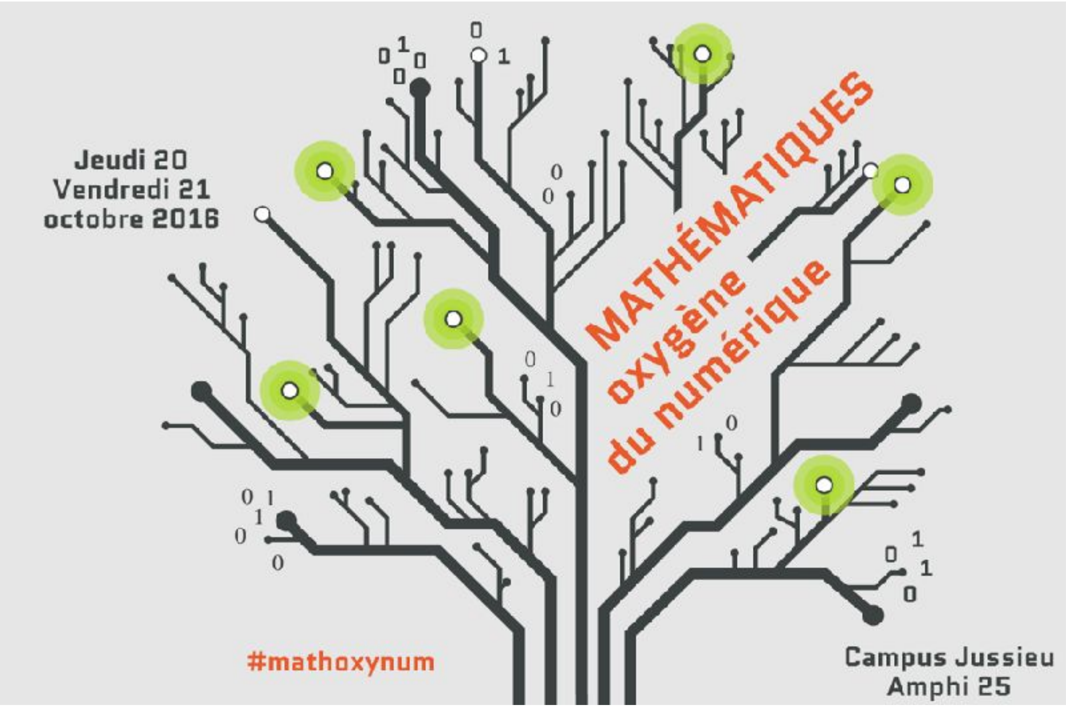




Dissemination

Ideas CERN

MIT SOLVE Learn Fuel Cure Make



Geneva - Switzerland

Boston - United States

Paris - France

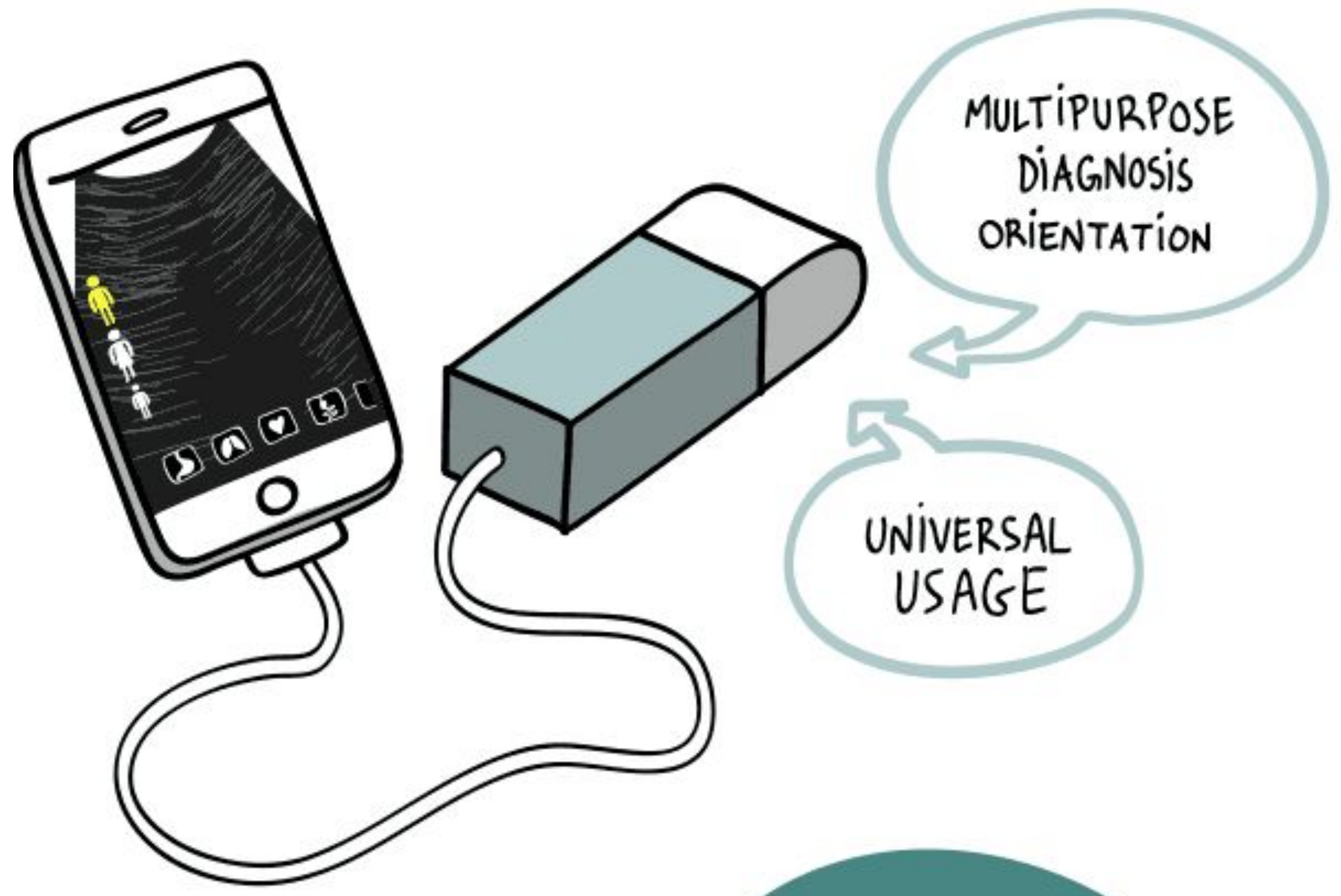
WORLDWIDE COMMUNITY

INVOLVED IN THE TECHNOLOGY DEVELOPMENT AND MEDICAL DEFINITION

source : echopen community file

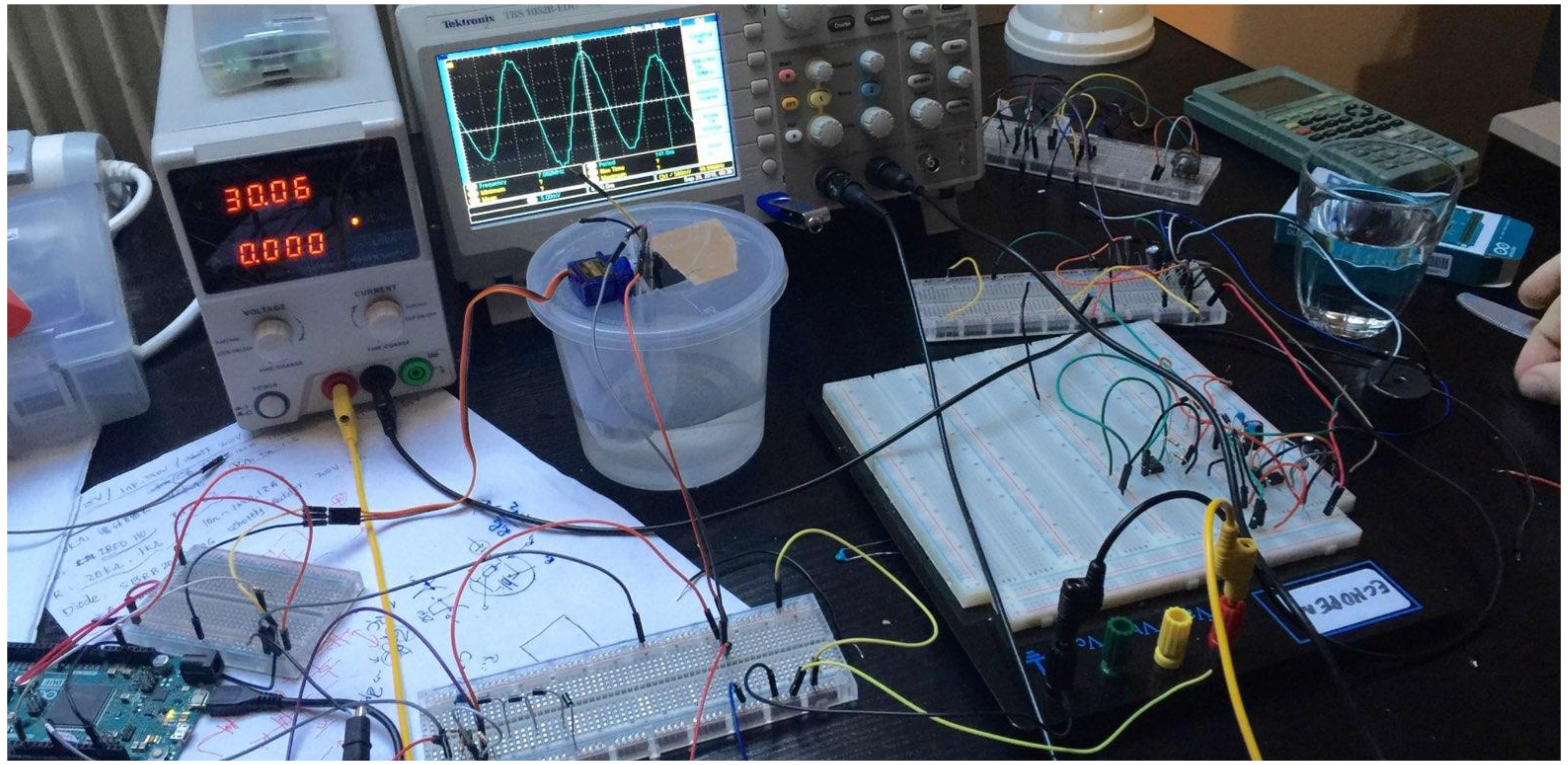
Outcomes

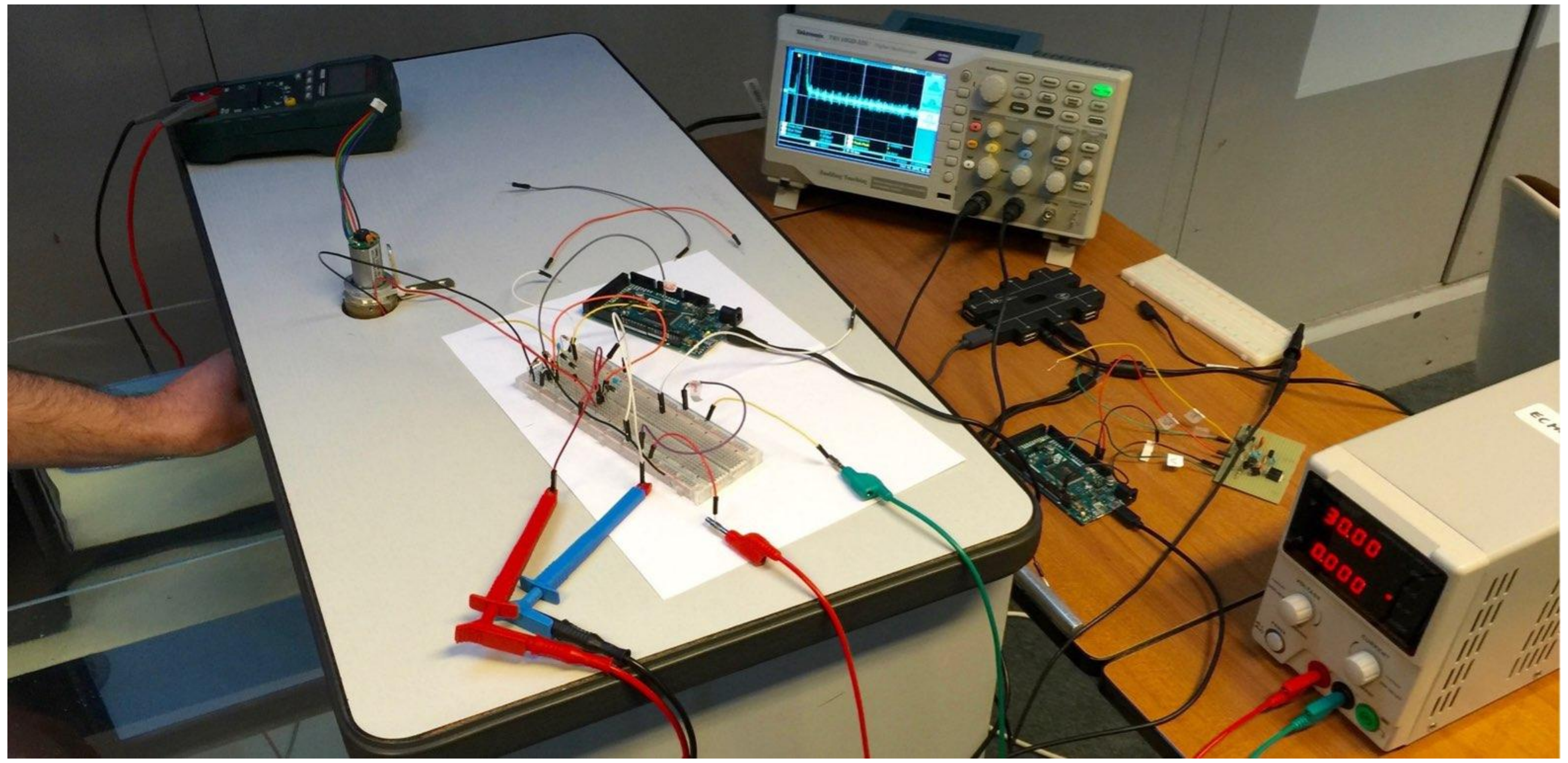
- 1 lab prototype (kit format split into modules) fully documented
- 1 high quality transducer
- 500+ people in the community (1/3 health professionals)
- 10 000+ participants in events (workshops, hackathons)
- 20 000+ people reached
- 60 000+ hours of skills given to the project

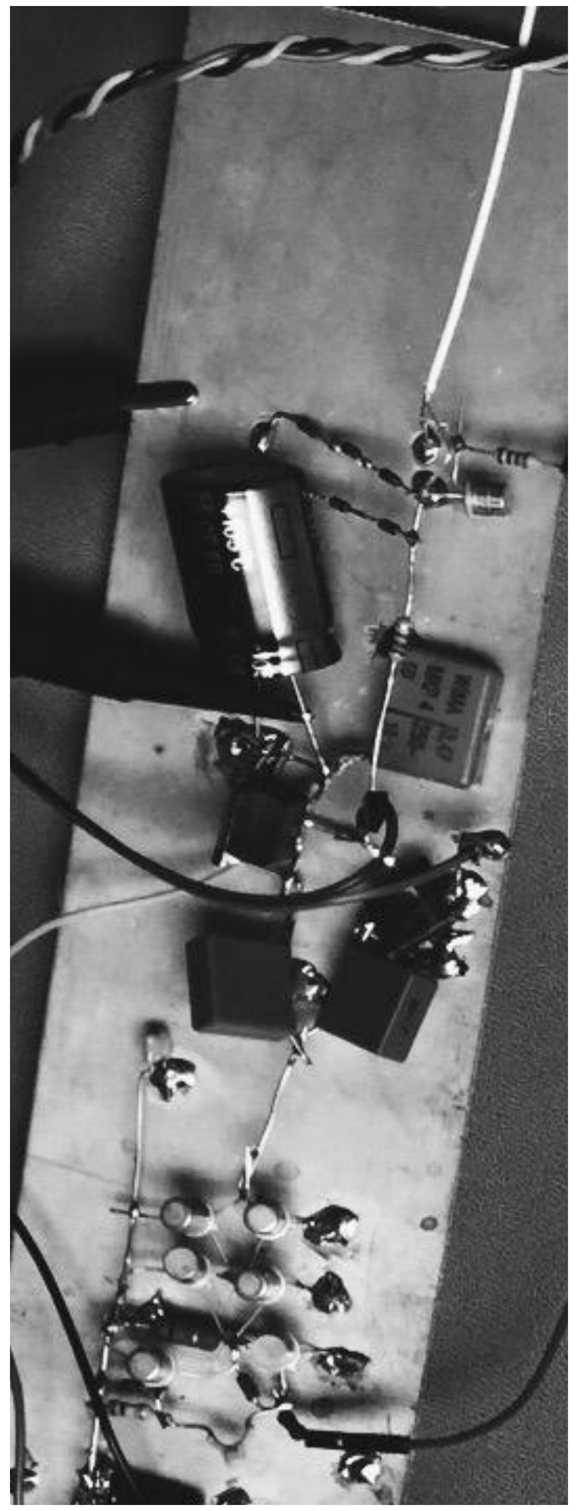


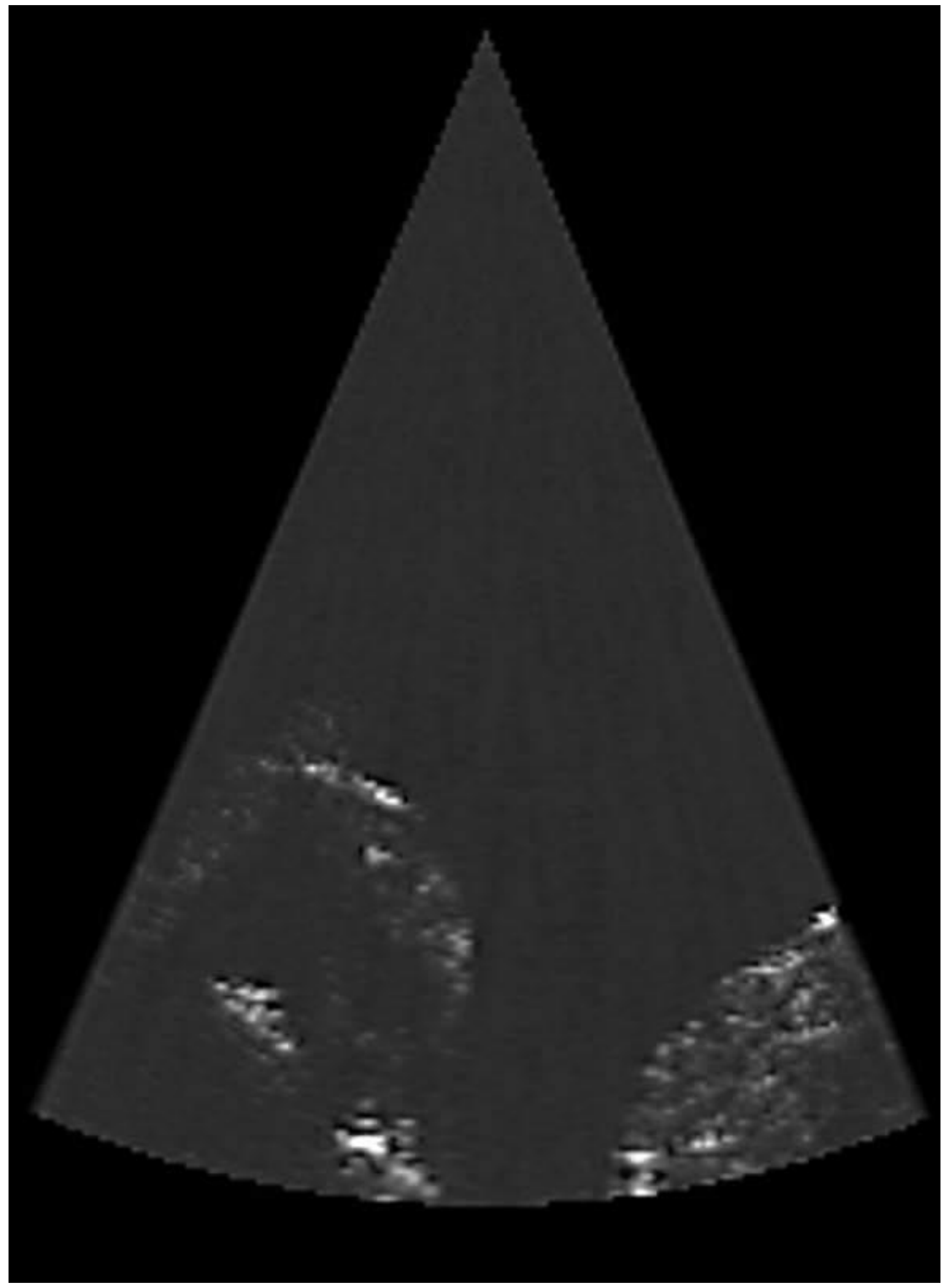
Making

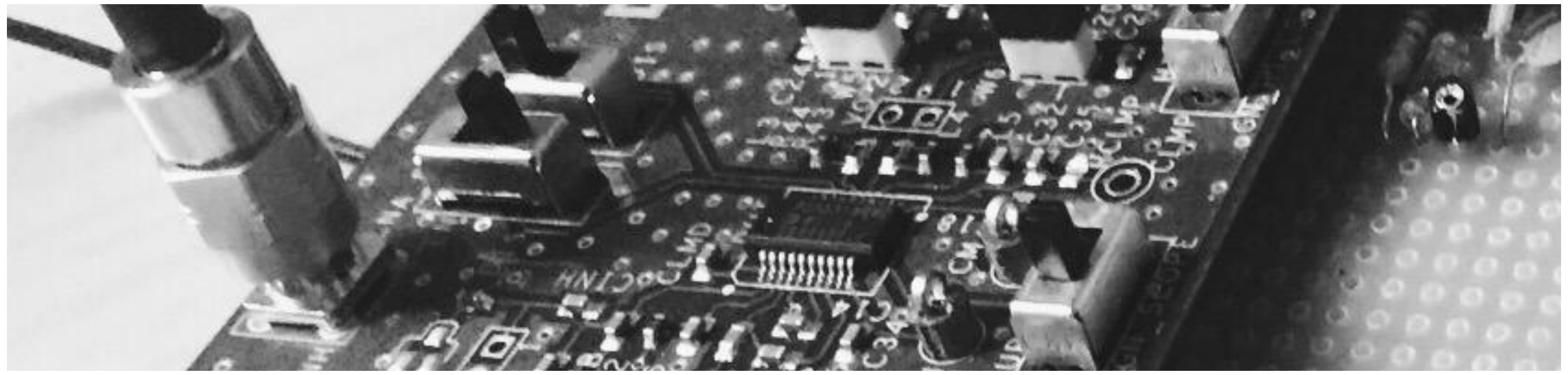
mid -2016



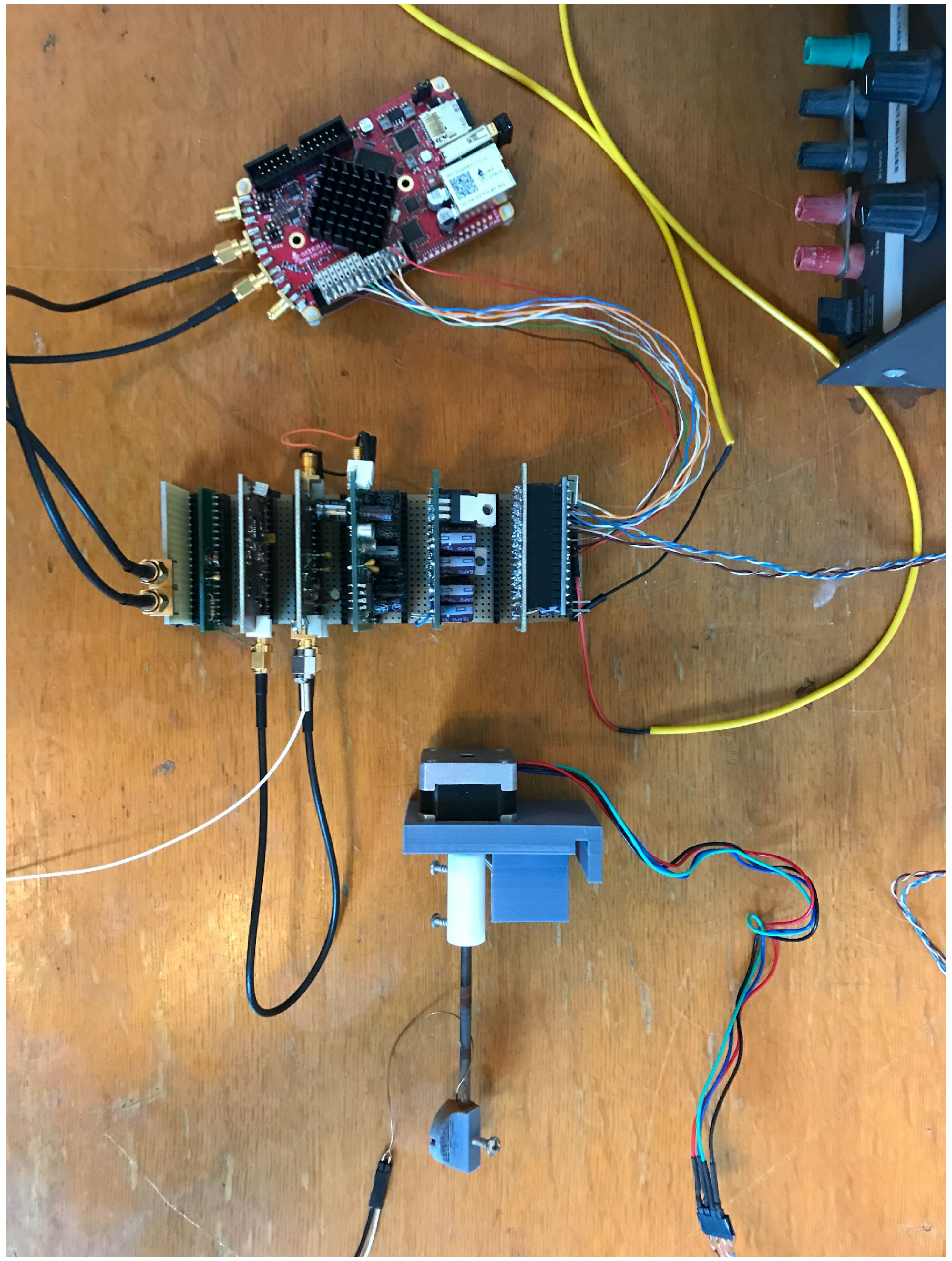








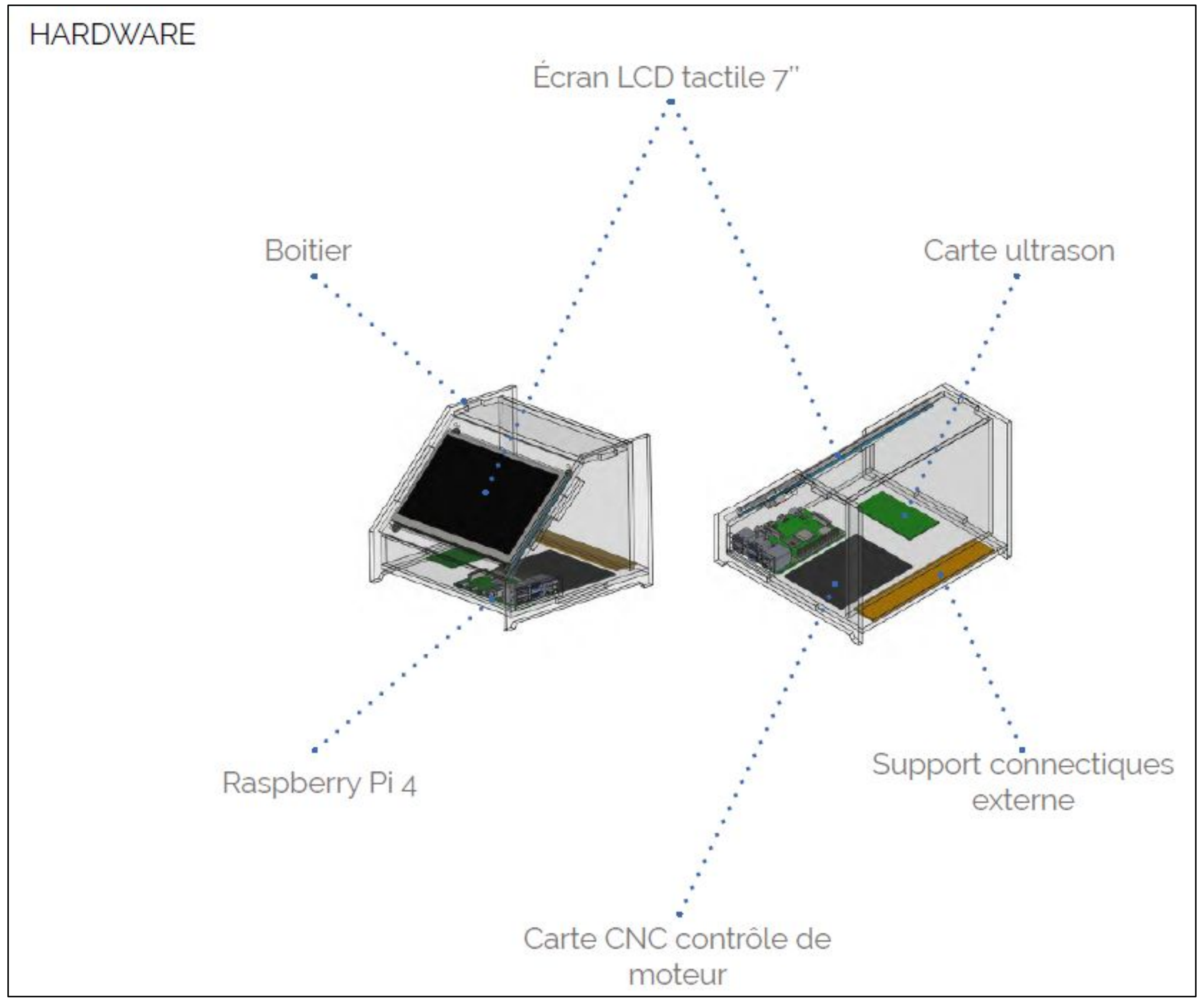
mid -2017

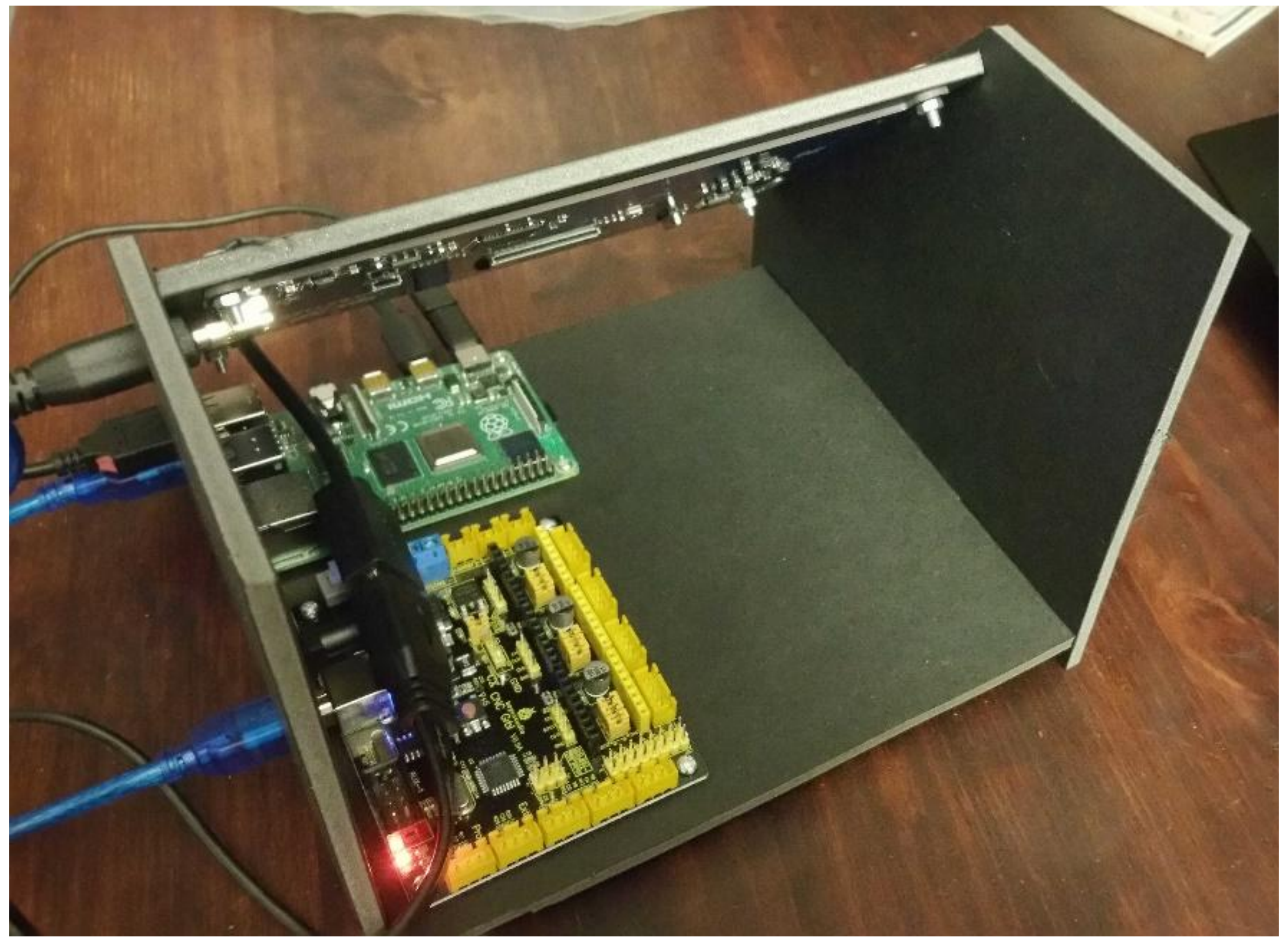


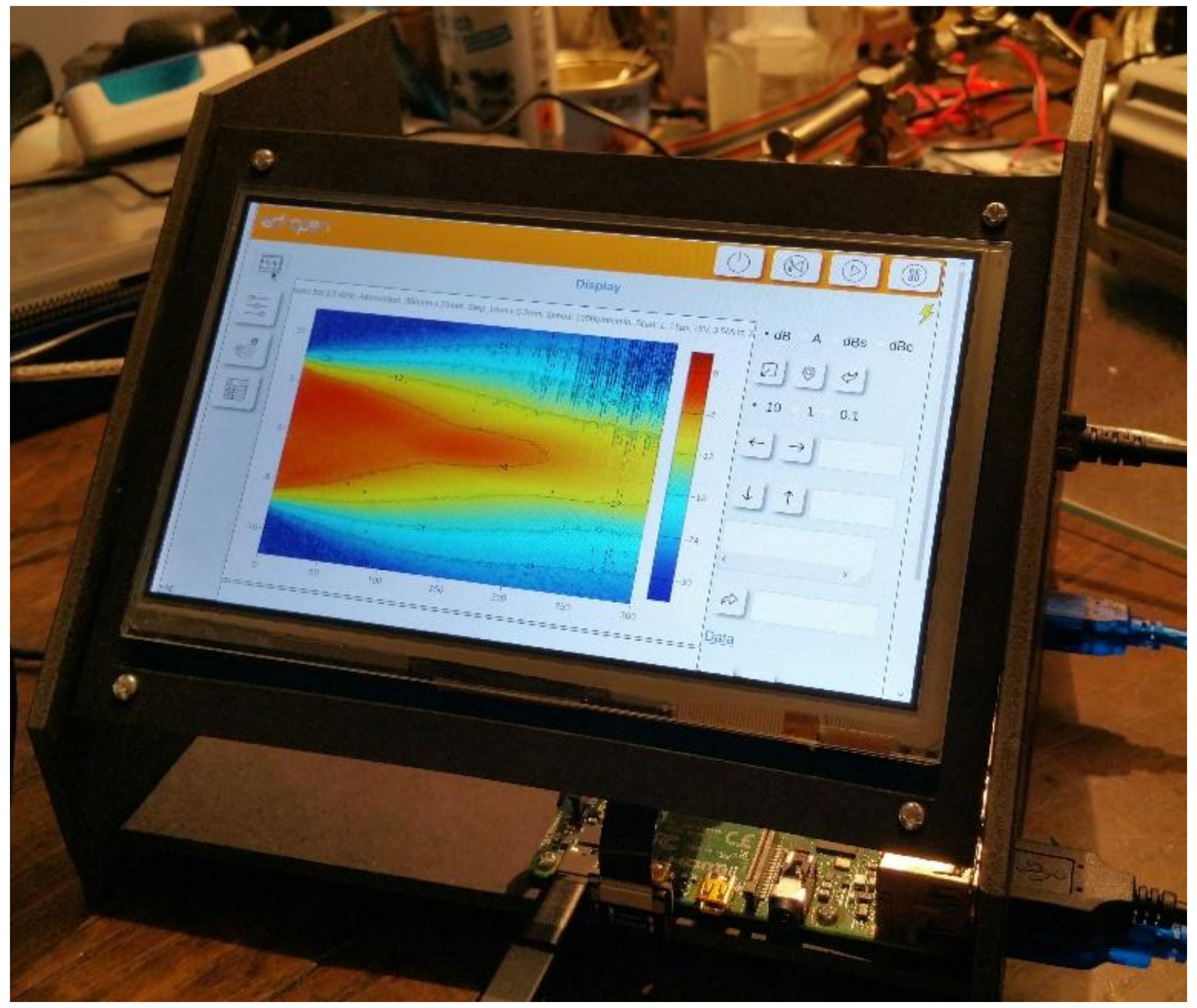
end 2019 - ELK (echOpen lab kit)

A Modular hardware lab kit to enable acoustic, software and firmware experiments

Demo in front of echOpen's Community on October 10.







Functional prototype

SOFTWARE
Low level Python API to drive all the components
Graphic app to execute experiments

Dissemination

Journal of open hardware

Bonvoisin, J et al. 2017 What is the "Source" of Open Source Hardware? *Journal of Open Hardware*, 1(1): 5, pp. 1–18, DOI: https://doi.org/10.5334/joh.7

ISSUES IN OPEN HARDWARE

What is the "Source" of Open Source Hardware?

Jérémy Bonvoisin*, Robert Mies†, Jean-François Boujut‡ and Rainer Stark*

What "open source" means once applied to tangible products has been so far mostly addressed through the light of licensing. While this approach is suitable for software, it appears to be over-simplistic for complex hardware products. Whether such a product can be labelled as open source is not only a question of licence but a question of documentation, i.e. what is the information that sufficiently describes it? Or in other words, what is the "source" of open source hardware? To date there is no simple answer to this question, leaving large room for interpretation in the usage of the term. Based on analysis of public documentation of 132 products, this paper provides an overview of how practitioners tend to interpret the concept of open source hardware. It specifically focuses on the recent evolution of the open source movement outside the domain of electronics and DIY to that of non-electronic and complex open source hardware products. The empirical results strongly indicate the existence of two main usages of open source principles in the context of tangible products: publication of product-related documentation as a means to support community-based product development and to disseminate privately developed innovations. It also underlines the high variety of interpretations and even misuses of the concept of open source hardware. This reveals in turn that this concept may not even be clear to practitioners and calls for more narrowed down definitions of what has to be shared for a product to be called open source. This article contributes towards this effort through the definition of an open source hardware lifecycle summarizing the observed approaches to open source hardware.

Keywords: open source hardware; open design; open innovation; open source innovation; open source product development

1 Introduction

In present times, we are witnessing increasing numbers of initiatives transferring product development and production from the private sector to the public. Enabled by the growing accessibility of affordable manufacturing technology, this is manifested in the expansion of the so-called "maker culture" which takes action to install participative production as an alternative to industrial production (Hatch 2013; Voigt, Montero, and Menichinelli 2016). The emergence of this culture is interwoven with the phenomenon of open source hardware (OSH), which transfers open source principles (as defined by Open Source Initiative 2007) from their origins in software development to the world of physical objects (Balka 2011: 4). While these new practices are raising significant attention, they are still in their infancy and struggle to reveal their full economic, social and environmental potential. One of the challenges they face is that sharing knowledge about atoms is not as frictionless as sharing bits.

Both practitioners and the scientific community generally acknowledge that online sharing of a piece of hardware is more difficult than the sharing of a piece of software (for example see discussion of this point in Raasch and Herstatt 2011). Software is digital by nature; it is made of series of characters—a format that can be shared and displayed online without specific tools, with a text editor being enough. Hardware may need to be described through more complex constructs like 2D or 3D schematics, which may require more specific software to be edited and displayed. Based on the evaluation of a pool of 20 OSH projects whose products embedded both software and hardware components, Balka, Raasch, and Herstatt (2014) highlighted that hardware components were generally less documented than the software components. This result raises questions in terms of practice. When a piece of hardware is poorly documented, is it still open source? What does "less documented" mean? What are the minimal requirements for labelling a hardware product as open source?

In the absence of clear guidance on this issue, it is not easy to draw a line between which piece of hardware is open source and which is not, even when licensing terms

* Institute for Machine-tools and Factory Management, Technische Universität Berlin, Berlin, DE

† Institute for Machine-tools and Factory Management, Technische Universität Berlin, Berlin, DE

‡ Collaborative Design Group, G-SCOP Laboratory, Grenoble Alpes University, Grenoble, FR

Corresponding author: Jérémy Bonvoisin, Chair of Industrial Information Technology (Jeremy.bonvoisin@tu-berlin.de)

What is the "Source" of Open Source Hardware?

ARTICLE IN PRESS

International Journal of Medical Informatics xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

ELSEVIER

International Journal of Medical Informatics

journal homepage: www.elsevier.com/locate/ijmedinf

The role of digital health in making progress toward Sustainable Development Goal (SDG) 3 in conflict-affected populations☆

Yara M. Asi[a,*], Cynthia Williams[b]

[a] Department of Health Management and Informatics, College of Health and Public Affairs, University of Central Florida, Orlando, FL, United States
[b] Department of Public Health, Brooks College of Health, University of North Florida, Jacksonville, FL, United States

A R T I C L E I N F O

Keywords:
Digital health
Conflict
Fragile states
SDGs
Health
Development

A B S T R A C T

Purpose: The progress of the Millennium Development Goals (MDGs) shows that sustained global action can achieve success. Despite the unprecedented achievements in health and education, more than one billion people, many of them in conflict-affected areas, were unable to reap the benefits of the MDG gains. The recently developed Sustainable Development Goals (SDGs) are even more ambitious then their predecessor. SDG 3 prioritizes health and well-being for all ages in specific areas such as maternal mortality, communicable diseases, mental health, and healthcare workforce. However, without a shift in the approach used for conflict-affected areas, the world's most vulnerable people risk being left behind in global development yet again. We must engage in meaningful discussions about employing innovative strategies to address health challenges fragile, low-resource, and often remote settings. In this paper, we will argue that to meet the ambitious health goals of SDG 3, digital health can help to bridge healthcare gaps in conflict-affected areas.
Methods: First, we describe the health needs of populations in conflict-affected environments, and how they overlap with the SDG 3 targets. Secondly, we discuss how digital health can address the unique needs of conflict-affected areas. Finally, we evaluate the various challenges in deploying digital technologies in fragile environments, and discuss potential policy solutions.
Discussion: Persons in conflict-affected areas may benefit from the diffusive nature of digital health tools. Innovations using cellular technology or cloud-based solutions overcome physical barriers. Additionally, many of the targets of SDG 3 could see significant progress if efficacious education and outreach efforts were supported, and digital health in the form of mHealth and telehealth offers a relatively low-resource platform for these initiatives. Lastly, lack of data collection, especially in conflict-affected or otherwise fragile states, was one of the primary limitations of the MDGs. Greater investment in data collection efforts, supported by digital health technologies, is necessary if SDG 3 targets are to be measured and progress assessed. Standardized EMR systems as well as context-specific data warehousing efforts will assist in collecting and managing accurate data. Stakeholders such as patients, providers, and NGOs, must be proactive and collaborative in their efforts for continuous progress toward SDG 3. Digital health can assist in these inter-organizational communication efforts.
Conclusion: The SDGS are complex, ambitious, and comprehensive; even in the most stable environments, achieving full completion towards every goal will be difficult, and in conflict-affected environments, this challenge is much greater. By engaging in a collaborative framework and using the appropriate digital health tools, we can support humanitarian efforts to realize sustained progress in SDG 3 outcomes.

1. Introduction

To bring progress to the world's development targets, the United Nations (UN) has twice agreed to a specific agenda to be achieved by all 189-member states. The first agreement was the Millennium Development Goals (MDGs) which were set for 2000–2015; the second agreement was the Sustainable Development Goals (SDGs), the current framework which is for 2015–2030. The MDGs were successful in achieving many of their targets. Estimates suggest that more than 21 million additional lives were saved during this period [50]. However, even early in the MDG period, reports warned that 'the MDGs cannot be achieved without more progress in fragile states'. Early data suggested that when compared to other low- and middle-income countries (LMIC), fragile states had significantly worse outcomes [28]. At the

☆ This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
* Corresponding author.
E-mail addresses: Yara.asi@knights.ucf.edu (Y.M. Asi), cynthia.white-williams@unf.edu (C. Williams).

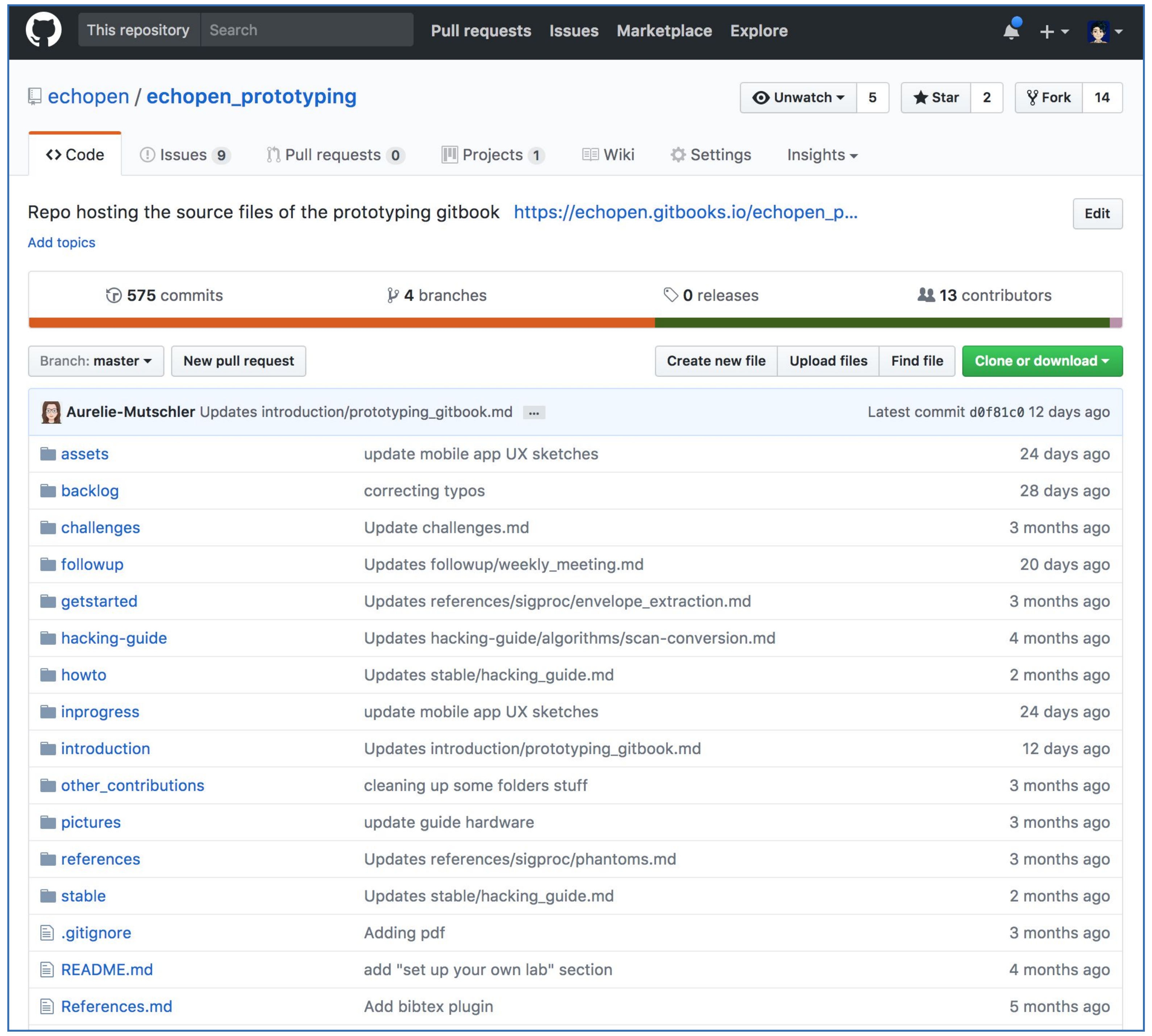
http://dx.doi.org/10.1016/j.ijmedinf.2017.11.003
Received 15 April 2017; Received in revised form 30 October 2017; Accepted 4 November 2017

Please cite this article as: Asi, Y.M., International Journal of Medical Informatics (2017), http://dx.doi.org/10.1016/j.ijmedinf.2017.11.003

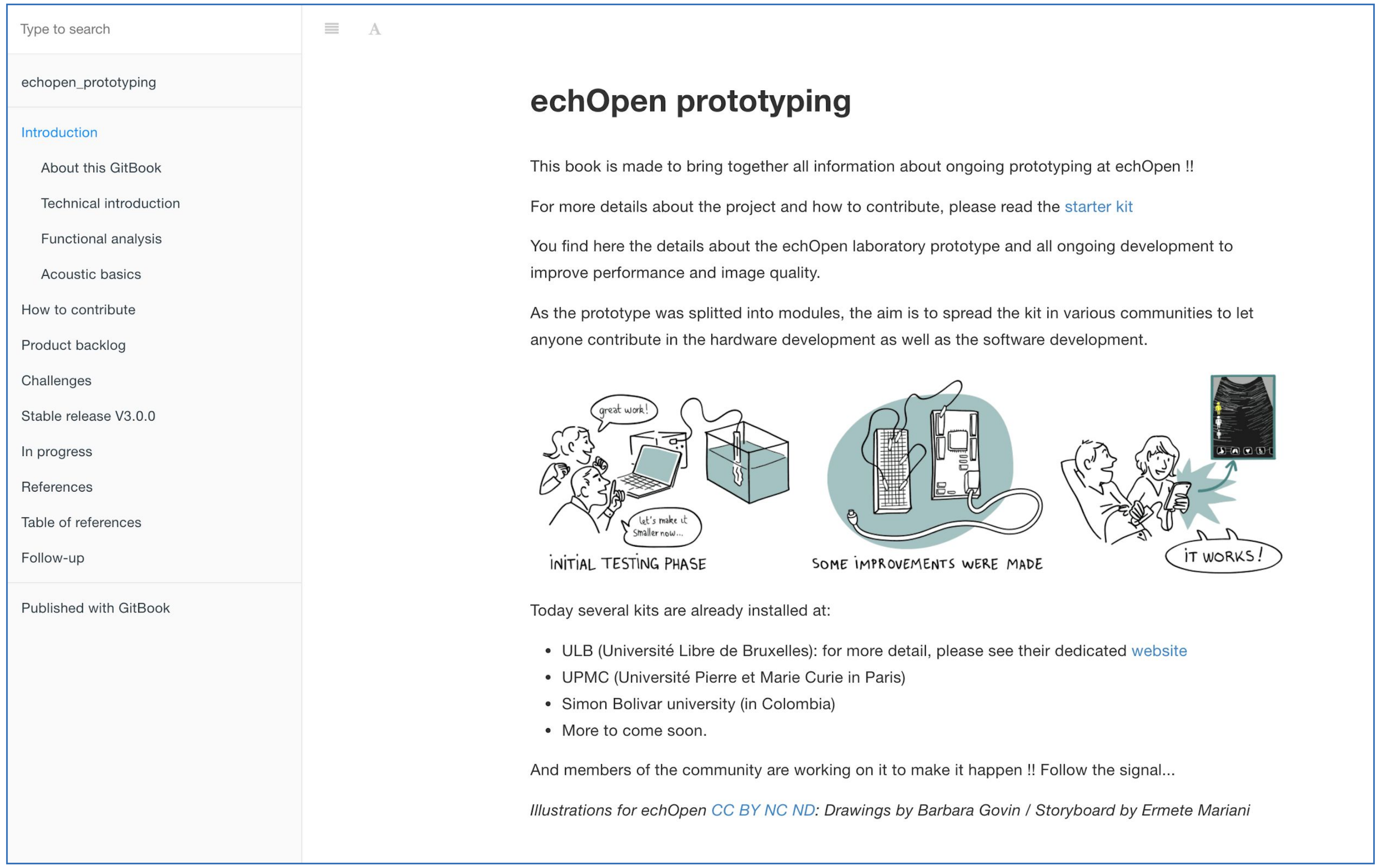
The role of digital health in making progress toward Sustainable Development Goal (SDG) 3 in conflict-affected populations

Documentation

GitHub

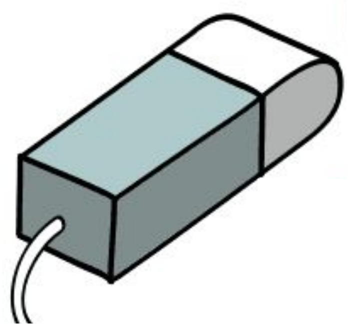


GitBook



echOpen common > 200 pages

Licences

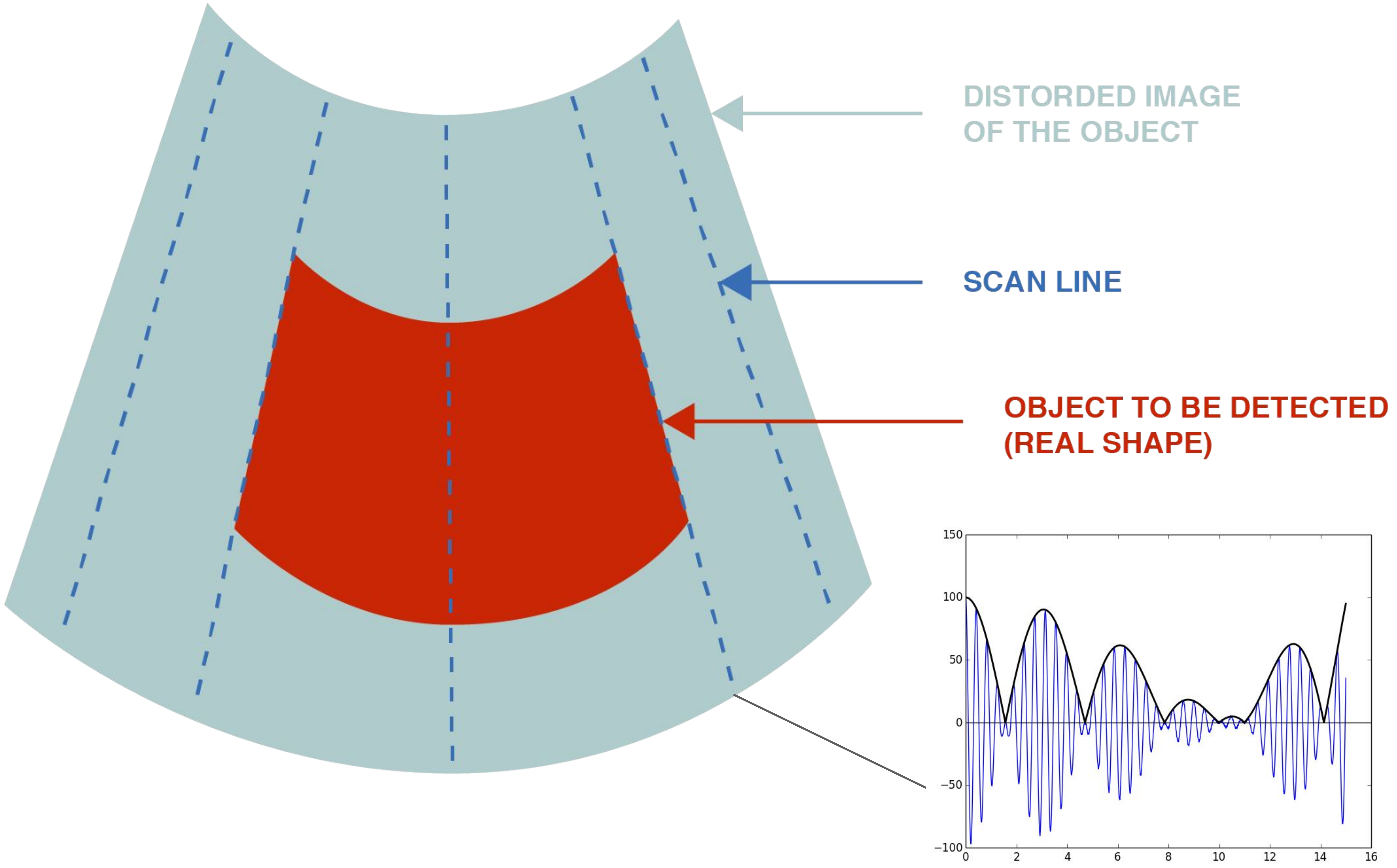


Hardware: echOpen license (equivalent to GPL 3 in Hardware)

Software: BSD 3

Content: CC BY SA

Scan conversion benchmark



Polar coordinates samples to cartesian images

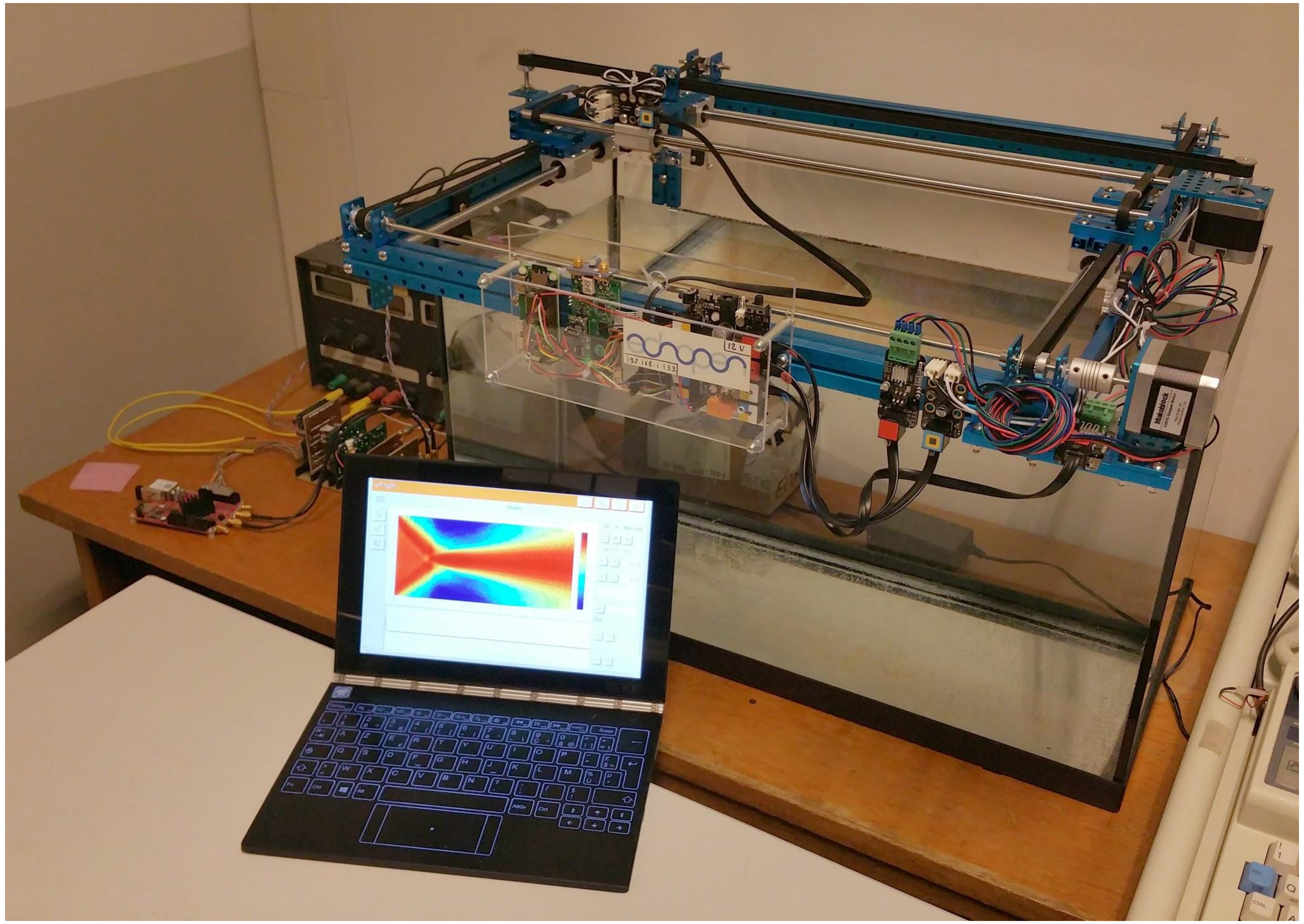
Ultrasound line and envelop

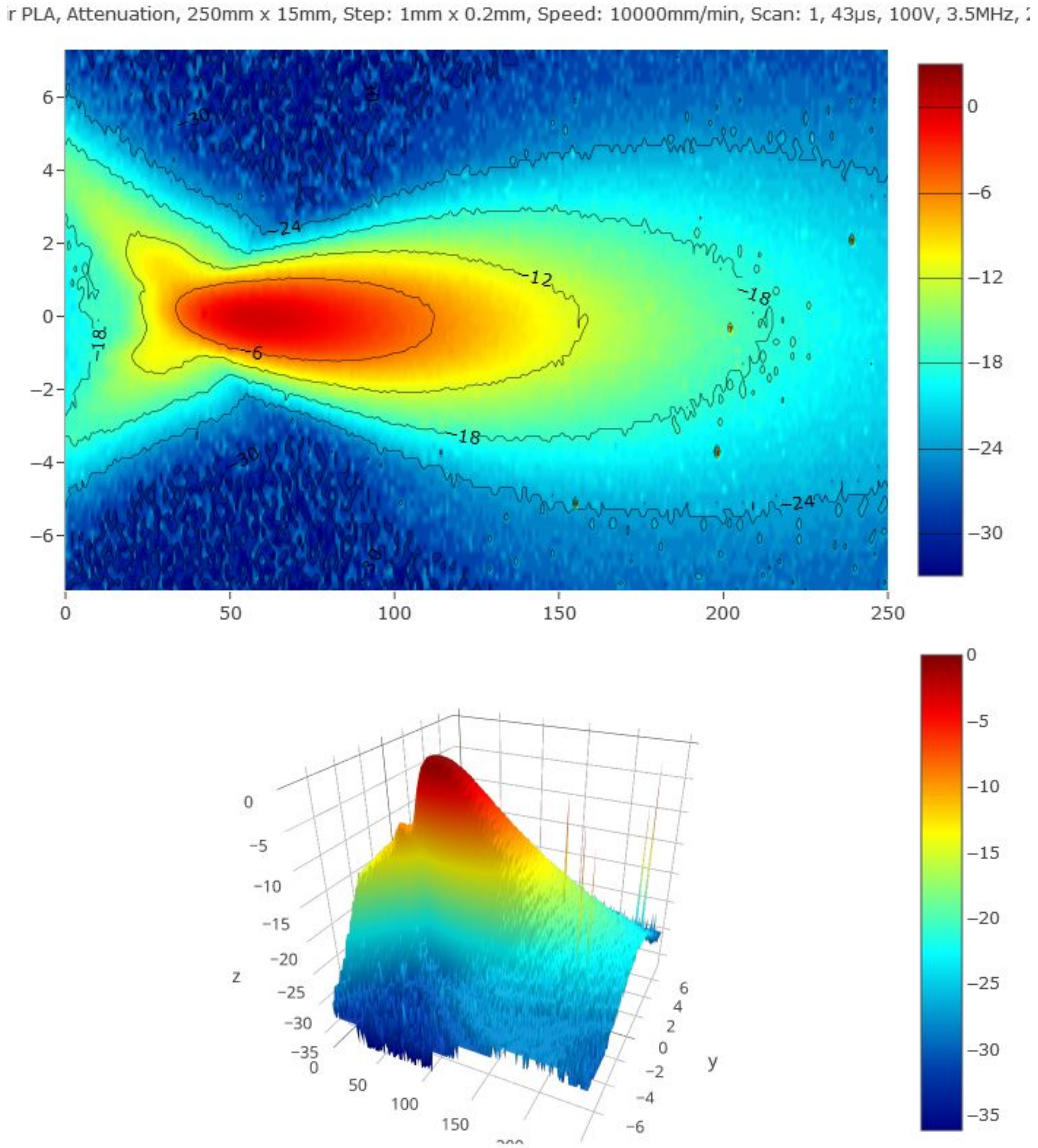
Multiples implementations on mobile app:

- **Home-made single threaded C++ scan conversion**
  10-12 FPS on a 512x512 image
- **OpenCV scan conversion**
  ~ 30 FPS on a 512x512 image
- **Renderscript**
  ~50 FPS on 512x512 image

Software

Transducer benchmark





Many more researches applications …

Contributing

E.L.K development

Weekly community meetings

contact@echopen.org

Provide equipment

slack.echopen.org

Open up your facilities

THANK **YOU!**