Making Sense

Advances and experiments
in participatory sensing

ONLINE TECHNICAL TOOLKIT

D2.1

DELIVERABLE

PROJECT ACRONYM	GRANT AGREEMENT #	PROJECT TITLE
Making Sense	688620	Making Sense

DELIVERABLE REFERENCE NUMBER AND TITLE

D2.1
Online Technical Toolkit

Revision: v1.0

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Project co-funded by the European Commision within the Call H2020
ICT2015 Research and Innovation action

DISSEMINATION LEVEL

✓ **P** **Public**

C Confidential, only for members of the consortium and the Commission Services

REVISION HISTORY

REVISION	DATE	AUTHOR	ORG...	DESCRIPTION
v0.1	25-09-2016	Mara Balestrini	IAAC	First draft
v0.2	28-09-2016	Tomas Diez	IAAC	Fablabs.io section editing
v0.3	28-09-2016	Gui Seiz	IAAC	Onboarding Section
v0.4	06-10-2016	Emma Pareschi	WAAG	Review
v1.0	09-10-2016	Gui Seiz	IAAC	Final Edit and Formatting

STATEMENT OF ORIGINALITY

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

SUMMARY

This deliverable describes the design and implementation of the Making Sense Toolkit. We present the aims of the toolkit and how they inform its design rationale.

One of the key aims of the Making Sense project is to collaboratively develop an online toolkit that curates, integrates and provides access to existing and bespoke technological solutions and methodologies for communities to assemble, deploy and maintain citizen-led campaigns to capture, share and make sense of open data about the environment. T

he resources comprised in the toolkit are co-designed, evaluated and iterated in the pilot interventions organised in Amsterdam, Barcelona and Prishtina where communities of interest and communities of practice collaborate to tackle environmental issues.

This report describes the different elements comprised in the Making Sense Toolkit, from methodological resources to descriptions of pilot projects and documentation of technical developments. We contribute screenshots and links to the tools that have been implemented so far and discuss their current and expected uses.

INDEX

1
INTRODUCTION

Making Sense is concerned with how to co-design and provide access to open source technology resources, methodologies and experiences that could infrastructure citizen sensing and science at the grassroots level.

Citizen and participatory science projects have typically been organised and managed by scientists and/or research organisations. This too often has limited the sustainability and scalability of the initiatives, which have been tied to research agendas and external sources of funding. However, when in hands groups of citizens that gather around a shared matter of concern, citizen sensing has the potential to enable new forms of civic and scientific action.

An approach to empower communities at the grassroots level to engage in citizen sensing and science is to produce open source and accessible resources, tools and methodologies that they can appropriate for their own situated purposes. Such resources should help citizens plan and deploy campaigns, appropriate and use open source sensing and data collection technologies, develop technical skills and data literacy, and collaboratively negotiate the governance and management of the resulting outcomes.

To this end, the aim of **WP2** is to develop a collaborative online toolkit that curates, integrates and provides access to existing and bespoke technological solutions and methodologies for communities to collaboratively assemble, deploy and maintain citizen-led campaigns to capture, share and make sense of open data about the environment. The resources comprised in the toolkit are co-designed, evaluated and iterated in the pilot interventions organised in Amsterdam, Barcelona and Prishtina where communities of interest and communities of practice collaborate to tackle environmental issues.

While Making Sense has already produced a considerable amount of technical and methodological resources, the tasks involved in the design and implementation of such a complex collaborative online toolkit are challenging.

The questions which guided the design rationale of the Making Sense online toolkit, are presented here.

- What tools can be used to document and share experimental technology developments?
- Should participants use established platforms such as GitHub or should we aim to adopt more “user friendly” platforms that are more inviting to people with lower tech expertise?
- How should the knowledge developed by the project partners and communities during the pilot interventions be aggregated and shared?
- How can the data that has been collected across pilots be visualised in a common platform, enabling comparison and sensemaking?

This report is structured as follows.

Section one presents the introduction and the aims of the Making Sense toolkit. Section two describes the toolkit’s different components organised according to the themes: pilot experiences, methodologies & insights, data, and technology & design innovation. Finally, a brief conclusion is presented in section three.

2
THE TOOLKIT

Making Sense will develop a collaborative online Toolkit as a knowledge and resource online environment.

The Making Sense toolkit aims to foster community appropriation of sensing technology infrastructures, encourage data sensemaking processes, embed technical and methodological skills and support learning among participants and across communities.

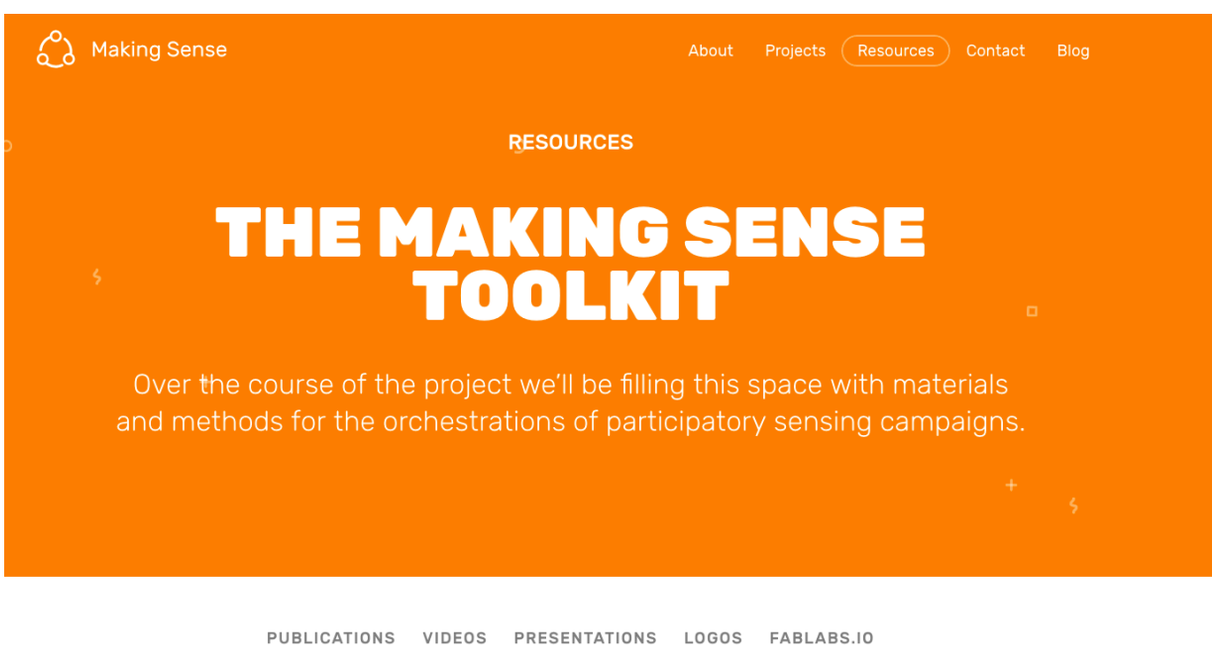


Figure 1. The Making Sense toolkit

The toolkit comprises the following parts: pilot experiences, methodologies & insights, data, and technology & design innovation. Through its different parts the toolkit facilitates access to technological resources such as software libraries, hardware firmware and digital designs for physical objects (suitable for 3D printers); through Fab Lab.io, which is the knowledge and communication exchange supporting the Fab Lab network (developed by Fab Lab Barcelona). It also aggregates feeds from social media sites such as Twitter, Youtube and Facebook through which users share their collective and personal experiences during the pilots. Its overarching goal is to infrastructure bottom up environmental monitoring campaigns.

To ensure the sustainability of the produced resources and foster their appropriation by external stakeholders, it was decided to follow a decentralised structure, leveraging existing repositories that are already being used by communities of makers and hackers.

The Making Sense website (www.making-sense.eu) acts as an aggregator of resources providing the overall narrative that links them together. Moreover, the open toolkit is accessible to any groups of citizens regardless of their participation in the Making Sense project.

Following, we explain and illustrate how each part of the toolkit has been implemented and used so far.

Making Sense Toolkit Organisation

SECTION	PILOT EXPERIENCES	METHODOLOGIES & INSIGHTS	DATA	TECH & DESIGN INNOVATIONS
WHAT	Description of pilots, issues, participants, pictures, etc.	Reports and publications	Data collected during the pilots	Step by step descriptions of technologies and designs co-developed during the project
WHERE	making-sense.eu/project	making-sense.eu/resources	SmartCitizen.me	FabLabs.io

2.1 Pilot experiences

Nine pilot interventions or campaigns are going to be organised in Amsterdam, Barcelona and Prishtina as part of Making Sense.

During these pilots participant communities use and or assemble open source sensing technologies to collect and share data that are relevant to the issue that they aim to tackle. Community coordinators also deploy and test engagement methodologies.

As a result, technologies are appropriated, data are collected and methodologies are developed and tested. The pilot descriptions provide the underlying narrative that ties these resources together, providing situatedness and meaningfulness. These descriptions are presented via the Making-sense.eu website and intend to be an engagening way to raise awareness about Making Sense and the online toolkit.

The pilot descriptions have a dedicated space under the tab projects in the Making-sense.eu website. As it can be seen in the image below, two pilots have already been organised both focusing on air quality, in Amsterdam and in Kosovo.

Figure 2. Making Sense pilot directory

Each pilot is represented with a bespoke icon and is described in an engaging way, including pictures and quotes from participants and community coordinators. Data about the number of participants, the environmental issue being tackled and the location of the deployments is presented in a salient manner (see Figure 3).

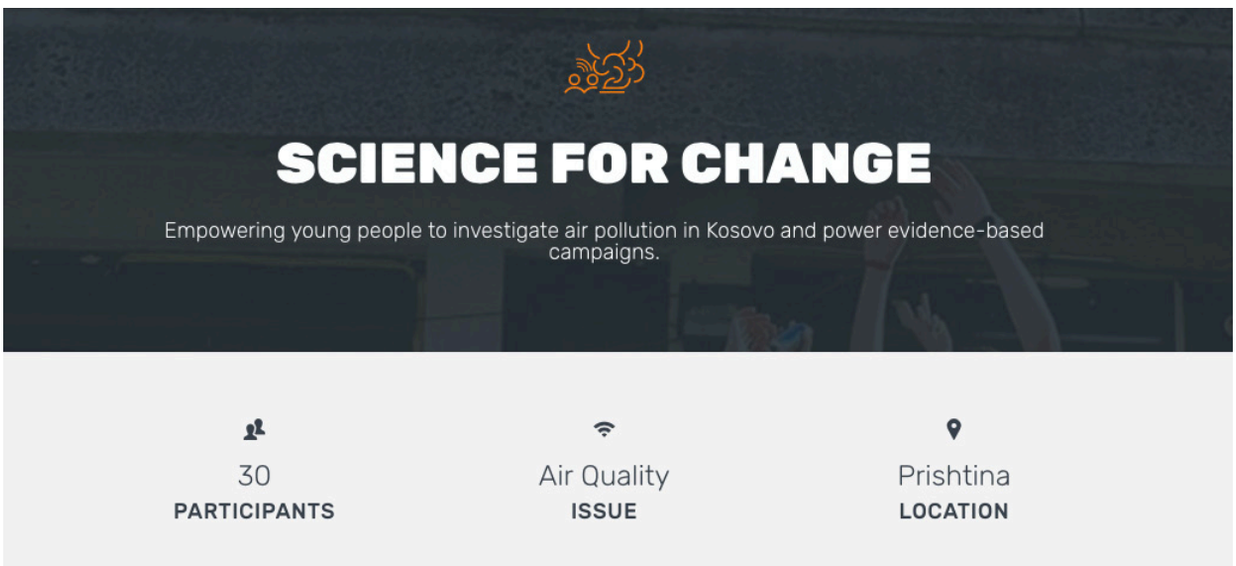


Figure 3. Pilot project page

Additionally, a description of the sensor technologies used in the data collection process is included, (as shown in figures 4 and 5).

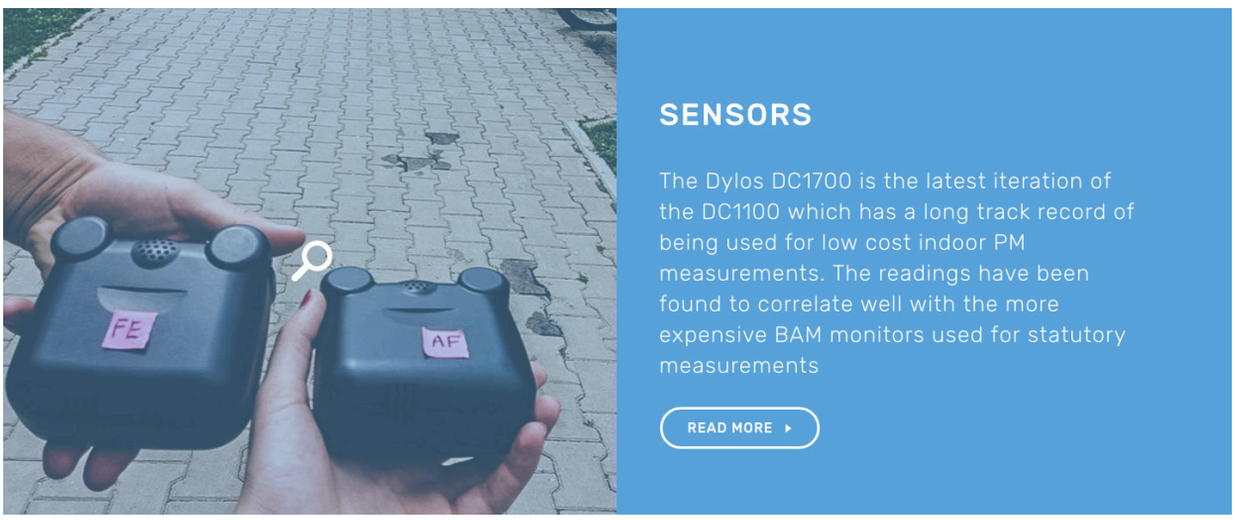


Figure 4. the sensors used in the Kosovo AQ pilot.

Figure 5. the sensors used in the Amsterdam AQ pilot.

2.2 Methodologies & Insights

The Making Sense Toolkit also includes know-how and information about the current landscape of citizen science and sensing across Europe, engagement methodologies and strategies for co-creation.

This content is covered in the deliverables produced by the project partners, submitted to the European Commission and made available to the general public. The deliverables are shared via the Making-sense.eu, and can be found under the resources tab, in the publications section.

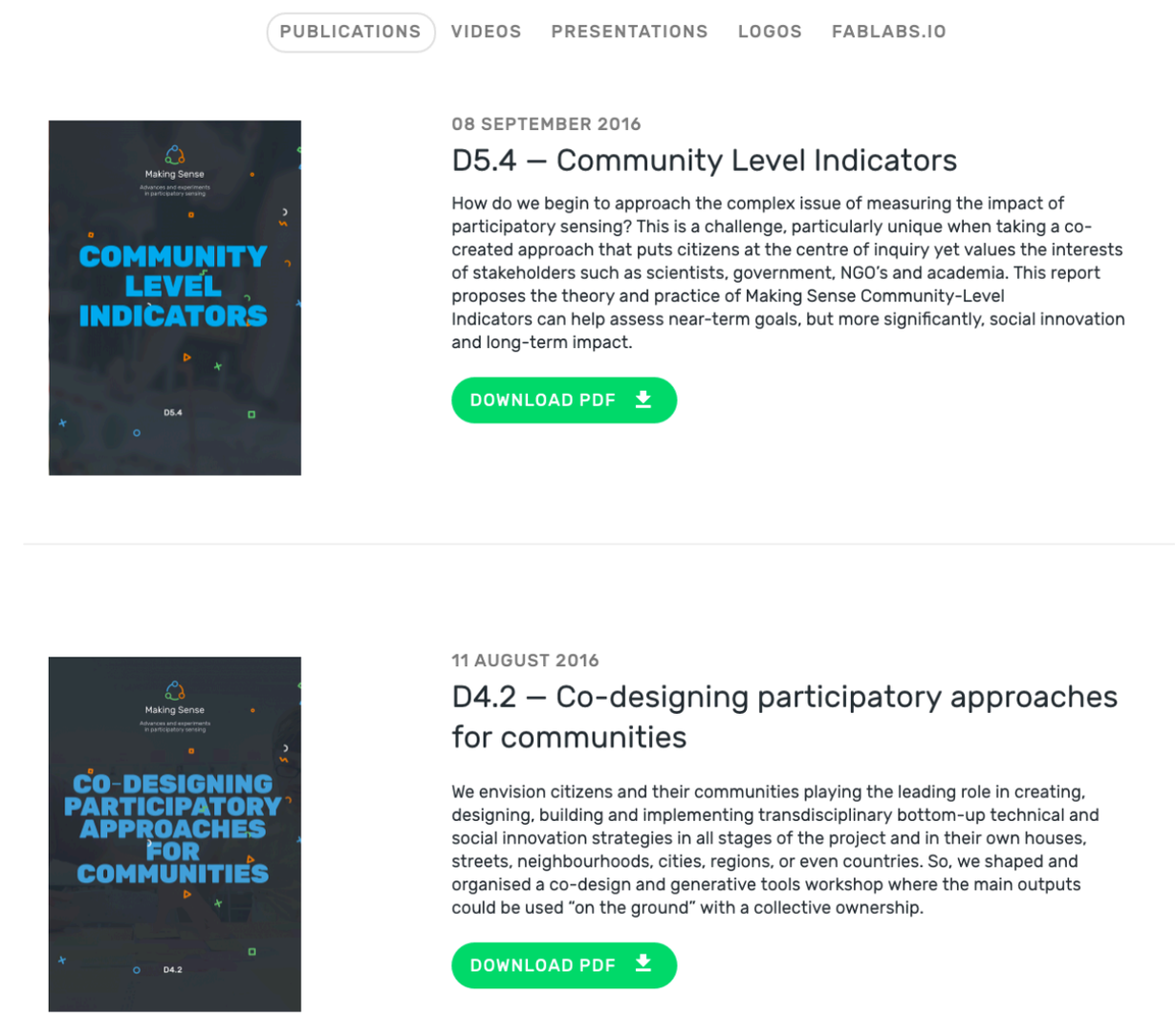


Figure 6. Making Sense deliverables directory

For example, figure 6 shows two deliverables that present findings on "*Community level indicators*" and on the co-design of *"participatory approaches with communities"*. Reports can be downloaded in a PDF format with a click and no signup process is required.

2.3 Data

During the pilots various data sets are collected pertaining to environmental phenomena such as air quality, noise levels, light pollution, etc.

These data, which are a cornerstone of the toolkit, are geotagged, aggregated and displayed via the Smart Citizen platform at smartcitizen.me, which is also accessible through the Making Sense website (http://making-sense.eu/about/). The Smart Citizen new data platform allows sensor users and pilot participants to upload, share, compare and integrate diverse data sets collected via Smart Citizen Kits and other means and sensors.

As shown in figure xx, the data can be visualised over a map. Data sources such as specific sensors can be selected for a more detailed analysis, clearly showing how the sensed phenomena changes in time. Moreover, the platform allows users to compare the ata retrieved by two distinct sources.

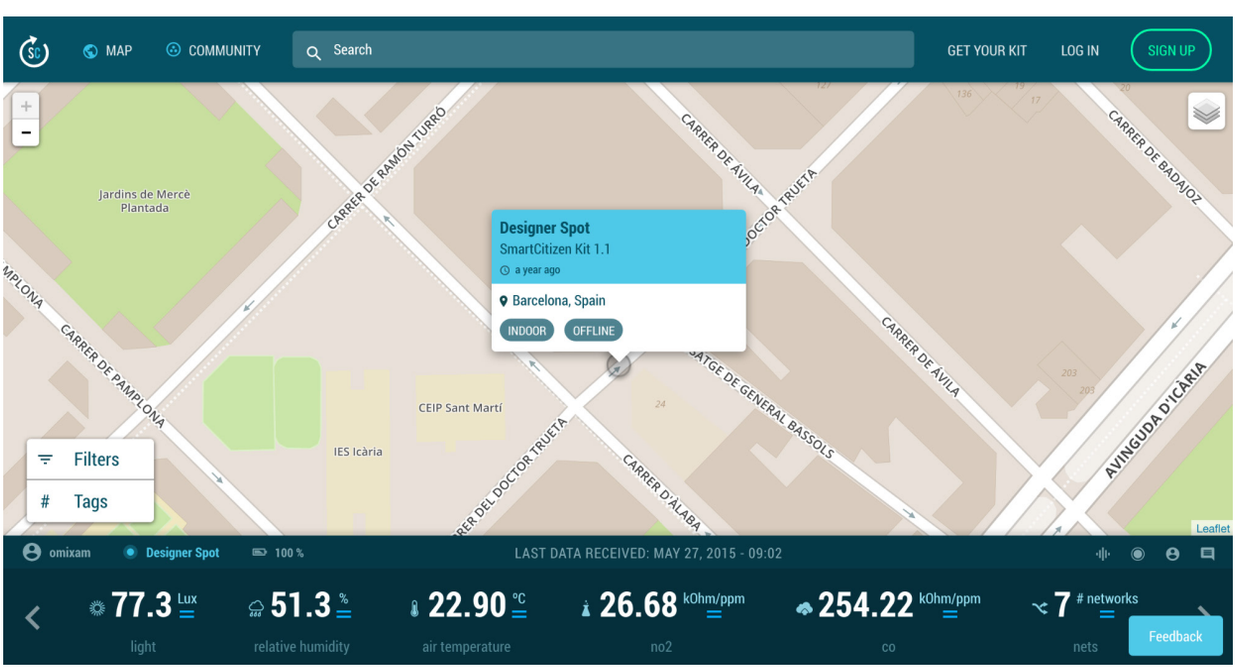


Figure 7. Smart Citizen platform - www.smartcitizen.me

Furthermore, a number of features have been designed to allow participants to use and make sense of the data collected. The following features describe possible scenarios that a community might want to experiment with as part of a Making Sense pilot: notifications, custom dashboards, data actuation, data in spreadsheets, Integration of custom devices. They focus on giving participants feedback about the data produced by the sensors towards supporting participation engagement and to help make sense of the data.

These developments have been covered in detailed in D2.3[1].

Notifications

In many cases users might find the need to trigger a notification when a certain event occurs on a Smart Citizen Kit. This might imply sending an email to the user or publishing a tweet (i.e. Notify the participants by twitter or email when battery is low).

Custom dashboards

When working on deployments that involve multiple devices a community might need to create their own page where the collected sensor data is updated in real time. This enables the possibility to look at the data from different spots at the same time as well as creating a sense of group among different sensor owners.

Data actuation

To support data sensemaking and make data actionable the Smart Citizen platform allows users to trigger actions in the physical environment. For example, it is possible to use real time data to control actuators in other devices like Arduino and Raspberry Pi (i.e. blink LED lights in Raspberry Pi enabled device if temperature, noise or light surpass a predefined threshold.

Data in spreadsheets

A way to introduce participants into examining the sense data is through the use of spreadsheets software such as Open Office, Microsoft Excel or Google Spreadsheets, to mention the most broadly used. Participants can upload their CSV files by simply using the File/Import option in Google Spreadsheets and no special settings are required.

Integration of custom devices

The Smart Citizen API supports other devices to publish data to the platform by previously agreeing with the Smart Citizen terms and conditions.

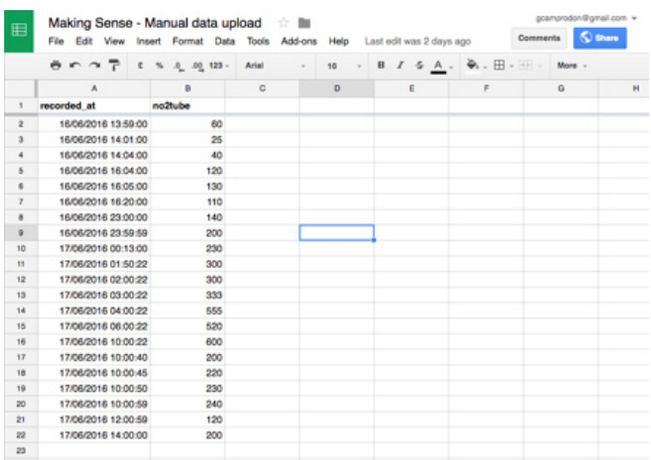
External data pulling

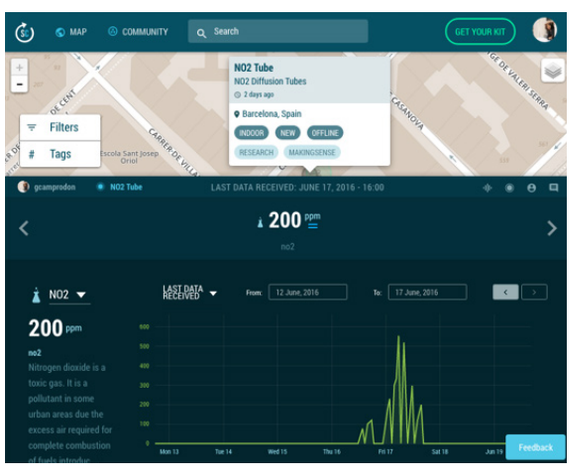
The system enabled users to use data that are already available via other open data platforms, or to integrate an industrial sensor that has its own proprietary data platform.

1 http://making-sense.eu/wp-content/uploads/2016/08/Making-Sense-D23-Smart-Citizen-Toolkit.pdf

Offline publishing

In certain situations, users might want to employ data capturing tools that can't connect to the internet. They might be deployed in places where there is no internet connection or they might be completely analog sensors, such as Diffusion Tubes often used to measure air quality. Nevertheless, the user might hope to visualize the collected data via the Smart Citizen platform. Users can now do this by using Google spreadsheets. An explanation of the procedure can be found in the toolkit through this link[2].





Figures 8 and 9. The Google Spreadsheet syncing data in real time to Smart Citizen.

2 https://www.fablabs.io/projects/158

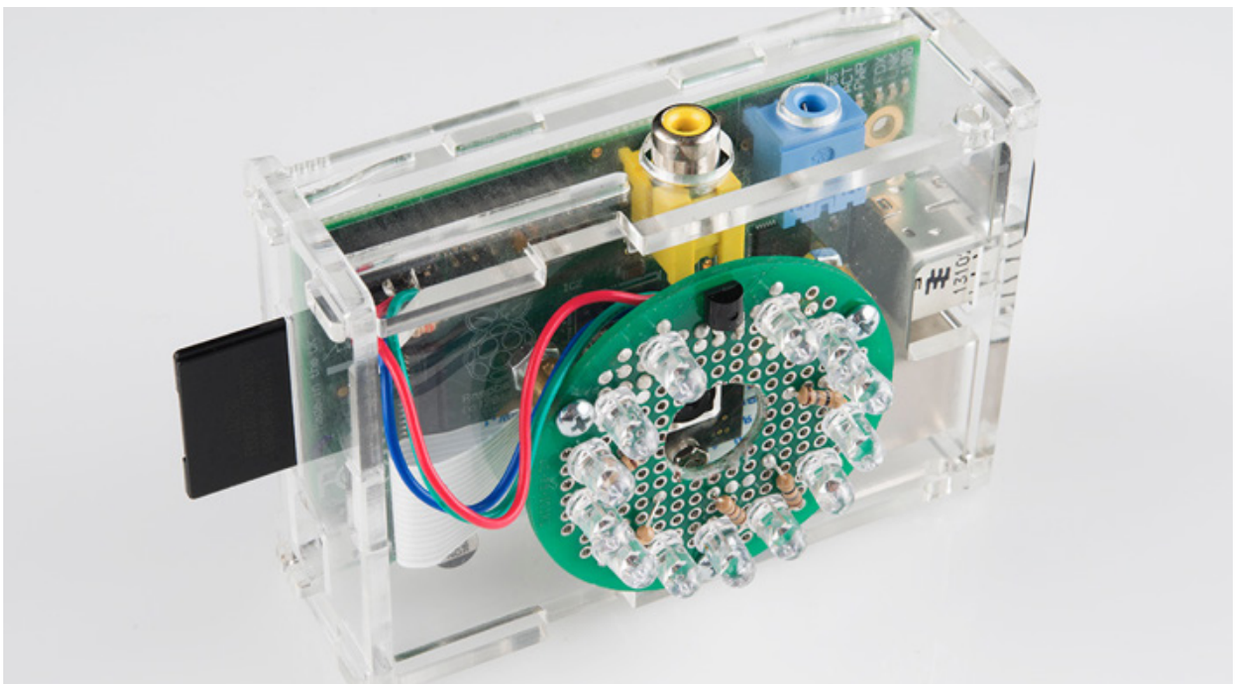


Fig 10. The time-lapse Pi Camera project by Sparkfun

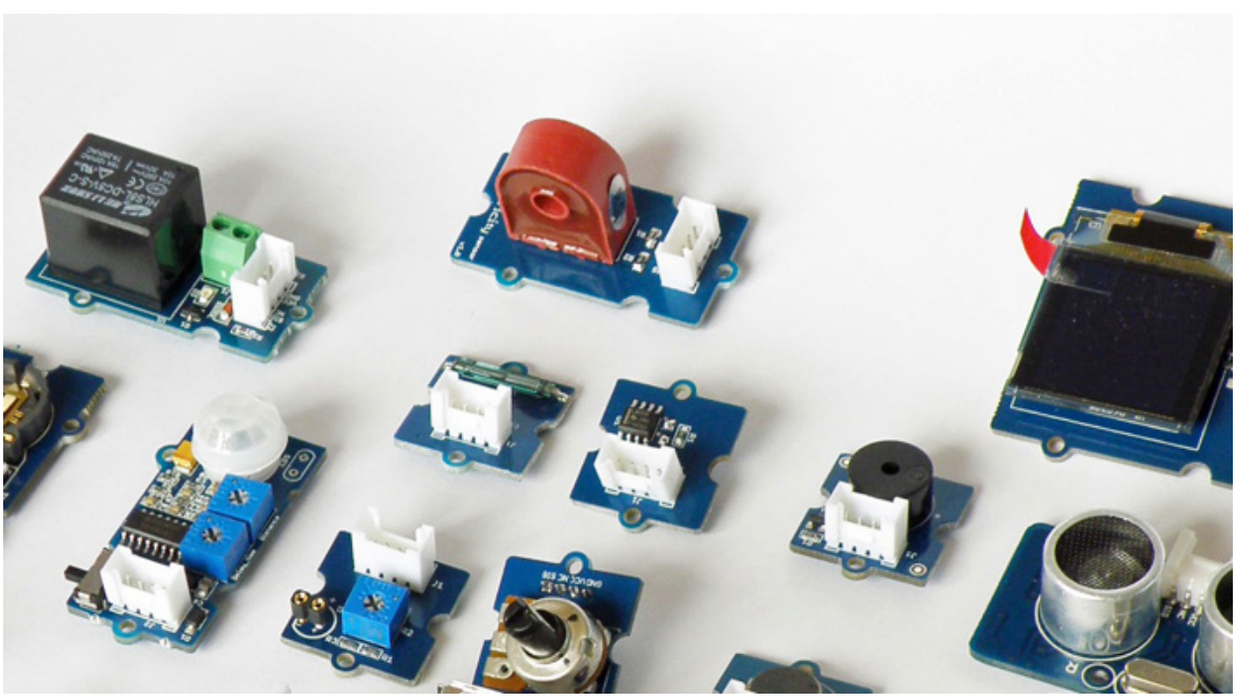


Fig 11. Seeed Studio Grove sensors and actuators that can be integrated to the Smart Citizen Kit

2.4 Technical & design innovations

FabLabs.io is an easy to use tool to share resources and a collaboration environment for the Fab Lab and makers communities.

By using FabLabs.io the technical and design innovations produced during the Making Sense project become embedded in the larger ecosystem of the Fab Lab network, which is an open, creative community of fabricators, artists, scientists, engineers, educators, students, amateurs, and professionals located in more than 75 countries.

As shown in figure 12, over 700 Fab Labs around the world are currently using this platform to share developments and collaborate online. The platform also fosters interactions between designers, makers and users, and aims to engage discussions about matters of concerns of the wider public in which Fab Labs are embedded, in cities and remote areas of the world.

FabLabs.io has been developed by the Fab Lab Barcelona team during the last 4 years, it is completely open source and has been forked by other Fab Labs (i.e. Amsterdam and Lima) and used as a tool for project sharing and community buildi

Figure 12. Global map of FabLabs on fablabs.io

As show in Figure 13, many of the developments that are instrumental to the Smart Citizen kit and platform have already been shared in FabLabs.io using the Making Sense tag.

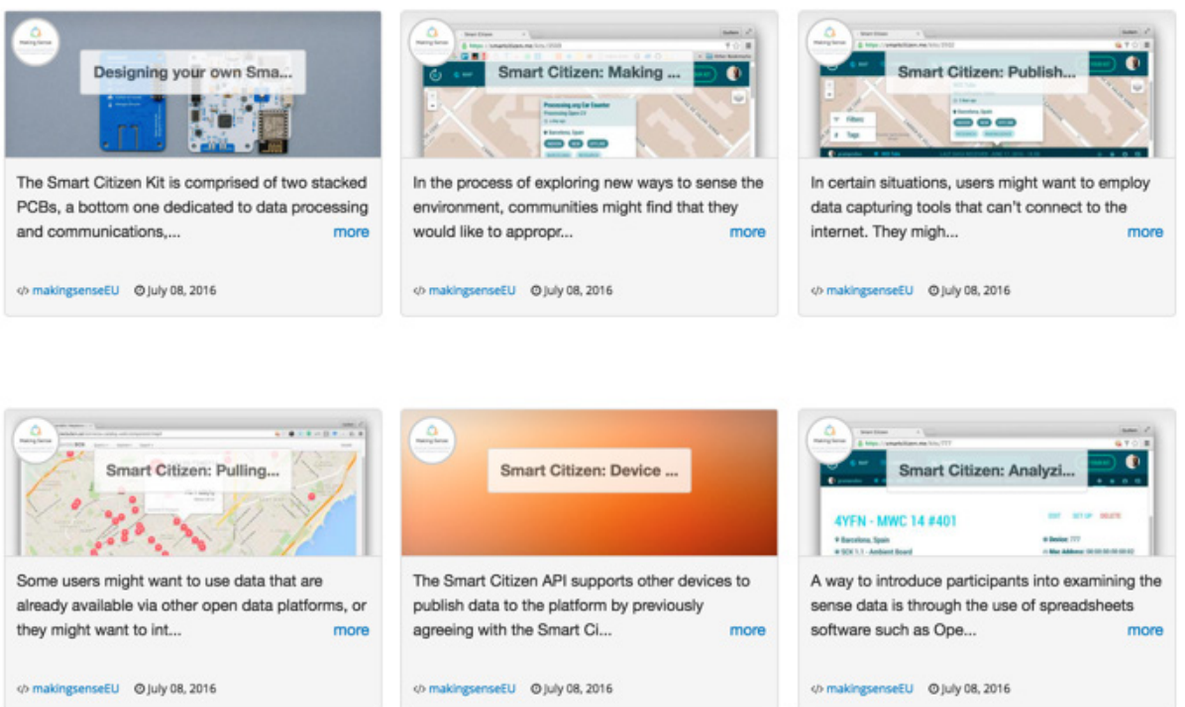


Figure 13. FabLabs.io project listing

Using FabLabs.io pilot participants and community coordinators can upload their creations in the form of projects, adding relevant information that helps socialise and explain the project. For example, each project description includes: name of the project, its owner and the contributors (people and labs), a description, tags, a step by step guide to facilitate its making and appropriation, links to external repositories and social media accounts, pictures and videos, and FAQs.

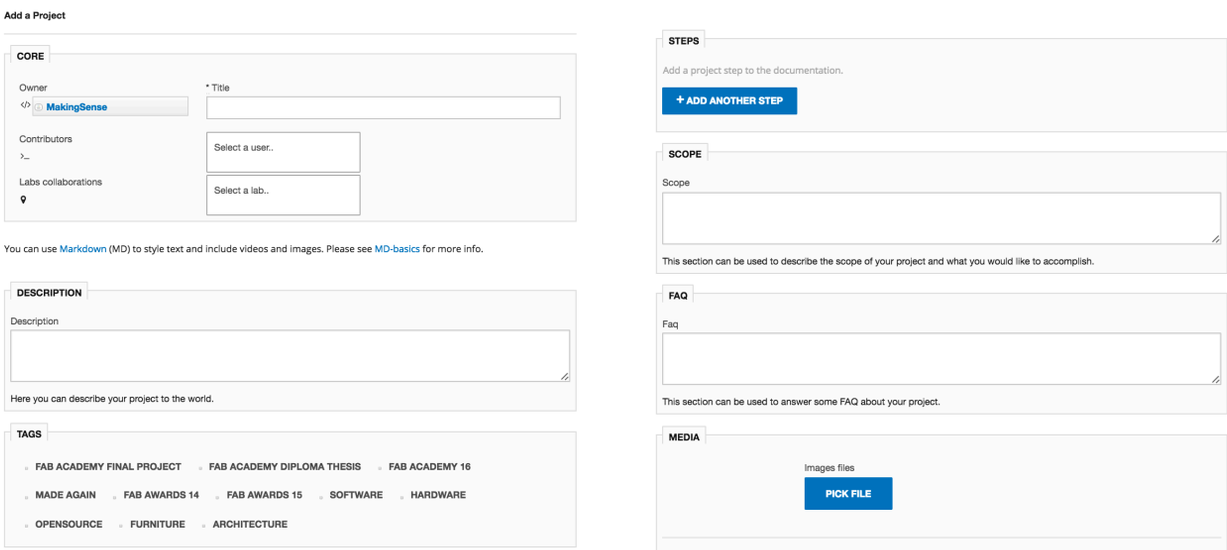


Figure 14a and 14b. Add Project and Steps on Fablabs.io

Fablabs.io is not intended to replace existing platforms such as Github, which are widely used by makers, hackers and technologists to document and share open source develpments. In fact, when adding a project to the FabLabs.io repository, it is possibe to include links to Github. However, we consider the adoption of Fablabs.io in Making Sense because it facilitates distributed collaborations across participants in different Fab Labs and it embeds their creations in the more specific ecosystem of the maker community

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Example

2.4.1 Sensor onboarding

An example of a significant technical and design innovation that has been produced during the first year of Making Sense, and contributed to the toolkit, in the Smart Citizen Kit onboarding.

It aims to facilitate the process of sensor setup to ensure that users, irrespective of technical expertise, can install the sensors and start collecting and sharing data during the pilots. As shown in the figures below (15 and 16), the new onboarding method guides the user through the process of the setup using simple language and a friendly graphic language.

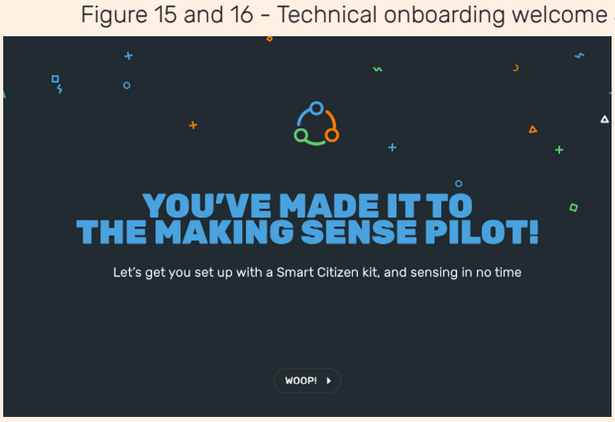
The improvements have been many. We have sought to tackle the main pain points of the sensor installation process, with a series of human centered design workshops.

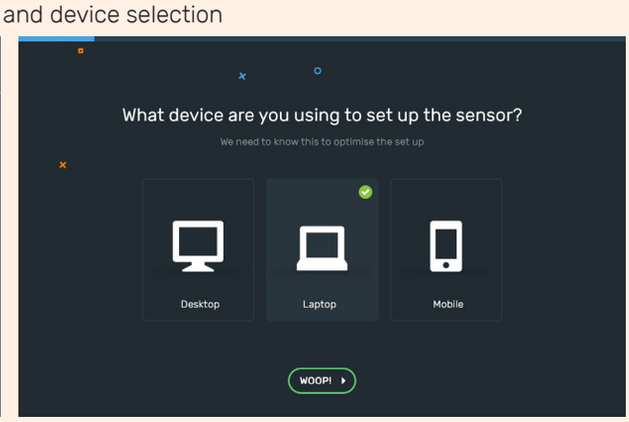
The original installation process was a fragmented experience which required users to be self guided and inquisitive as they found themselves searching what the next step was by navigating to different parts of the Smart Citizen platform. At times the installation process was overtly technical and asked of users tasks such as downloading drivers and disabling and re-enabling security permissions. The onboarding often needed extra hardware not included with the device, such as cables, and also lacked any instruction or description of the contents within the box.

Furthermore the installation process often asked for inconsequential information or personal information with no explanation for why or how that personal information might be used. We addressed these issues with tried and tested User Experience patterns such as clear sign posting and completeness meters, based on well researched human biases like 'the Speak-easy Effect' which states that we inherently trust words that are easier to say[3] [4], and the 'Sunk cost effect', where we are less likely to pull out of something we have invested effort into, or see near completion[5].

The most obvious improvement was condensing the installation process into one linear journey as opposed to many tangential tasks, which often felt disconnected. Now the participants are able to install the sensor step by step along a path that gives you completeness feedback as users move through the steps.

Figure 15 and 16 - Technical onboarding welcome and device selection





The graphic language now allows for contextual sensemaking. Components are described in words with accompanying descriptions as well as animations. Signposting has also been improved, with the messaging clearer and purposeful. When asked for information or permissions, users are prewarned and context is served that explains why such information is necessary.

3 Song & Schwarz (2007) If It's Difficult to Pronounce, It Must Be Risky. Psychological Science

4 http://carlo-hamalainen.net/stuff/Reber_Schwarz_Perceptual_fluency.pdf

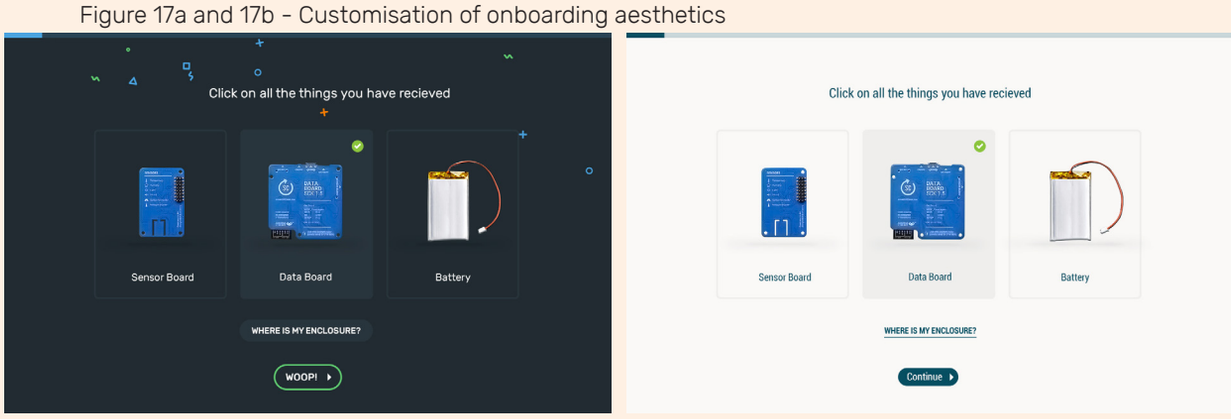
5 Arkes, Hal R., and Catherine Blumer, "The psychology of sunk cost", Organizational Behavior and Human Decision Processes, Vol. 35, No. 5, December 1985, 124-140.

Perhaps most importantly the hand-shake / pairing process, where the sensor syncs to the participant's computer, has been rebuilt from the ground up. Whereas before users would go through hurdles of selecting a wifi network on computer, open a mini application and select another wi-fi network, and then jump back to the original network, now the pairing process happens by flashing a light pattern from the monitor to the light sensor, which identifies the computer, and pairs it with the sensor on the platform.

The entire process has been built in such a way that it's optimised for a variety of devices. Users can therefore benefit from the same experience whether they are on a desktop computer, a laptop or a touch device (Figure 16).

Finally, the technical onboarding has been developed to be campaign friendly, and easy to rebrand to represent different project's aesthetics, as well as messaging. Project orchestrators need only to fill in a small number of text boxes to add campaign specific description and imagery to the onboarding process.

Figure 17a and 17b - Customisation of onboarding aesthetics



We will continue to iterate the technical onboarding as we collect insights from the pilot participants installation experiences, to provide an increasingly more robust solution.

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CONCLUSION

In this report we have presented the design and implementation of the Making Sense Online Toolkit, a knowledge and resource environment that aims to foster citizen participation in citizen science and sensing.

The goal is to contribute and share open source technology and design innovations, methodologies for campaign orchestration, open data and know-how and learning in an accessible and engaging way.

Of major importance is the sustainability of these contributions, which should survive and continue to evolve in hands of citizens even after the Making Sense project has ended. This poses a number of challenges that have strongly influenced the design decisions addressed in this report. With the Making Sense Toolkit we hope to contribute to the development of novel and useful resources to infrastructure new forms of civic participation in bottom-up science and sensing.

Making Sense

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