



Grant Agreement No.: 732078  
 Call: H2020-ICT-2016-2017  
 Topic: IOT-02-2016 – IoT Horizontal Activities  
 Type of action: CSA



## D1.2: Crowdsourcing and survey tool for LSPs

---

Work package	WP 1
Task	Task 1.2
Due date	31.12.2017
Submission date	04.01.2018
Deliverable lead	Mandat International
Version	1.0
Authors	Cédric Crettaz (Mandat International), Christopher Hemmens (Mandat International)
Reviewers	Wim Vanobberghen (imec), Jonas Breuer (imec), Cesco Reale (Archimede Solutions)

Abstract	The U4IoT project provides a crowdsourcing and survey tool for the Large Scale Pilots (LSPs) to facilitate end-user engagement for each LSP. This document presents the crowdsourcing and survey tool for the Large Scale Pilots (LSPs) and explains how to use it.
Keywords	Crowdsourcing, survey, LSP, IoT

### Document Revision History

Version	Date	Description of change	List of contributor(s)
V0.1	06/09/2017	1 <sup>st</sup> draft with the table of contents	Cédric Crettaz (Mandat International)
V0.2	22/09/2017	First complete version	Cédric Crettaz (Mandat International)
V0.3	27/09/2017	Reviewed by Chris Hemmens	Christopher Hemmens (Mandat International)
V0.4	22/12/2017	Review and Modifications	Wim Vanobberghen (imec), Jonas Breuer (imec), Christopher Hemmens (Mandat International), Cédric Crettaz (Mandat International)
V1.0	28/12/2017	Final version	Cédric Crettaz (Mandat International)

### DISCLAIMER

The information, documentation and figures available in this deliverable are written by the User Engagement for Large Scale Pilots in the Internet of Things, U4IoT;

project's consortium under EC grant agreement 732078 and do not necessarily reflect the views of the European Commission.

The European Commission is not liable for any use that may be made of the information contained herein.

## COPYRIGHT NOTICE

© 2017 - 2019 U4IoT Consortium



Co-funded by the  
European Union



Co-funded by the  
Swiss Confederation

## ACKNOWLEDGMENT

This deliverable has been written in the context of a Horizon 2020 European research project, which is co-funded by the European Commission and the Swiss State Secretariat for Education, Research and Innovation. The opinions expressed and arguments employed do not engage the supporting parties.

Project co-funded by the European Commission in the H2020 Programme		
Nature of the deliverable:		OTHER
Dissemination Level		
<b>PU</b>	Public, fully open, e.g. web	✓
<b>CL</b>	Classified, information as referred to in Commission Decision 2001/844/EC	
<b>CO</b>	Confidential to FLAME project and Commission Services	



## EXECUTIVE SUMMARY

The U4IoT project is a Coordination and Support Action (CSA) for the European Large Scale Pilots (LSPs) in the context of the Internet of Things (IoT). The goal of the U4IoT project is to facilitate the end-user engagement for LSPs. To achieve its objective, the project provides the LSPs with a toolkit for end-user engagement including online resources, guidelines, a privacy game for personal data protection risk assessment, online training modules and finally, crowdsourcing tools, the latter of which are described in this document.

The crowdsourcing tools are composed of three elements: a mobile application with a strong focus on crowdsourcing and crowd-sensing; a website permitting interactions between users and IoT devices (users' smartphones and the IoT testbeds' sensors and actuators); and a survey tool. The LSPs will be able to use the application to push surveys to specific groups of users for direct feedback and collate all the data using the website. Not only that, but the application can also collect data from users' smartphones (dependant on them granting permission) and providing quantitative data on top of the qualitative data.

All the tools described in this document were developed and tested as part of the European IoT Lab project (Oct 2013 - Sep 2016) - a research platform exploring the potential of crowdsourcing and Internet of Things for multidisciplinary research with increased user interactions - it was then improved to fit with the requirements of U4IoT.

This document describes and explains the improved versions of the crowdsourcing tools provided initially by IoT Lab. This document can be considered as a user guide for the LSPs and it is addressed to the partners of the five LSPs and their end-users.

## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>4</b>
<b>TABLE OF CONTENTS .....</b>	<b>5</b>
<b>LIST OF FIGURES .....</b>	<b>6</b>
<b>ABBREVIATIONS .....</b>	<b>7</b>
<b>SECTION 1: THE MOBILE APPLICATION.....</b>	<b>8</b>
Introduction .....	8
How to use the mobile application.....	8
<b>SECTION 2: THE WEBSITE.....</b>	<b>33</b>
Introduction .....	33
How to use the website.....	33
<b>SECTION 3: THE SURVEY TOOL .....</b>	<b>50</b>
Introduction .....	50
How to use the survey tool .....	50
<b>CONCLUSIONS.....</b>	<b>56</b>

## LIST OF FIGURES

FIGURE 1: WELCOME TEXT.....	9
FIGURE 2: ETHICAL PRINCIPLES AND LICENSE AGREEMENT .....	10
FIGURE 3: SHARING SETTINGS .....	11
FIGURE 4: DOMAINS OF INTEREST FOR THE USER .....	12
FIGURE 5: ANONYMISED SOCIO-ECONOMIC PROFILE.....	13
FIGURE 6: HOMEPAGE OF THE MOBILE APPLICATION .....	14
FIGURE 7: LIST OF RESEARCH PROJECTS .....	15
FIGURE 8: THE RESEARCH PROJECT IN WHICH THE USER IS CURRENTLY TAKING PART .....	16
FIGURE 9: DETAILS OF A RESEARCH PROJECT .....	17
FIGURE 10: LIST OF SURVEYS.....	18
FIGURE 11: EXAMPLE OF A SURVEY .....	19
FIGURE 12: BUTTON TO PROPOSE A NEW IDEA .....	20
FIGURE 13: PROPOSE A NEW IDEA .....	21
FIGURE 14: IDEAS PROPOSED BY THE OWNER OF THE PHONE.....	22
FIGURE 15: IDEAS RANKED BY RATING.....	23
FIGURE 16: IDEAS RANKED BY DATE .....	24
FIGURE 17: IDEAS RANKED BY CATEGORY .....	25
FIGURE 18: AN EXAMPLE OF AN IDEA.....	26
FIGURE 19: USER'S IDEA.....	27
FIGURE 20: A RESOURCE ON THE MAP .....	28
FIGURE 21: NOTIFICATIONS ON THE HOMEPAGE.....	29
FIGURE 22: NOTIFICATION .....	30
FIGURE 23: ABOUT .....	31
FIGURE 24: SETTINGS.....	32
FIGURE 25: FORM TO BE COMPLETED BY A NEW USER .....	33
FIGURE 26: MAIN PAGE FOR THE RESEARCHER .....	34
FIGURE 27: FORM FOR A NEW RESEARCH PROJECT .....	35
FIGURE 28: RESEARCH DASHBOARD .....	35
FIGURE 29: RESEARCH PROJECTS .....	36
FIGURE 30: DASHBOARD OF A RESEARCH PROJECT .....	37
FIGURE 31: IOT INTERACTIONS.....	37
FIGURE 32: RESOURCE RESERVATION.....	38
FIGURE 33: RESOURCES OF A MOBILE PHONE.....	39
FIGURE 34: RESOURCE SELECTION.....	40
FIGURE 35: RESERVED RESOURCE .....	40
FIGURE 36: SELECTION OF SENSORS AND ACTUATORS .....	41
FIGURE 37: RESOURCES PROVISIONING .....	42
FIGURE 38: SCENARIO COMPOSITION.....	42
FIGURE 39: FINALISE THE SCENARIO .....	43
FIGURE 40: RESULTS OF AN EXPERIMENT .....	44
FIGURE 41: RESULTS.....	44
FIGURE 42: UPLOAD REPORTS .....	45
FIGURE 43: NOTIFICATION.....	46
FIGURE 44: MY ACTIVITY LOG.....	47
FIGURE 45: GET INSPIRED.....	47
FIGURE 46: ONGOING RESEARCH.....	48
FIGURE 47: MY PROFILE .....	49
FIGURE 48: SURVEY TOOL.....	50
FIGURE 49: CREATE SURVEY .....	51
FIGURE 50: NEW SURVEY CREATED.....	52
FIGURE 51: LISTS OF PARTICIPANTS .....	53
FIGURE 52: A LIST OF PARTICIPANTS .....	54
FIGURE 53: SENDING A SURVEY.....	55

## ABBREVIATIONS

<b>CSA</b>	Coordination and Support Action
<b>IoT</b>	Internet of Things
<b>LSP</b>	Large Scale Pilot

## SECTION 1: THE MOBILE APPLICATION

### INTRODUCTION

The mobile application used for the U4IoT project is an improved version of the mobile application developed during the IoT Lab project. The main features of the mobile application are as follows:

- The ability of the mobile application user to participate in research and related experiments.
- The sharing of data generated by the smartphone's sensors.
- The ability of the user to participate in surveys linked to research.
- The ability to propose new ideas and suggestions.
- The ability to rate ideas proposed by other users.

The main limitation of the IoT Lab mobile application was that it was only available on Android phones. The updated application for U4IoT has been rewritten using Xamarin<sup>1</sup> meaning that it is now also available for iOS.

The user interface has been updated with a new, more modern look that aids the user experience and several bugs in the original application have been fixed.

The IoT Lab platform and the U4IoT project have the same goal: to encourage the general public to change the world by using new technologies related to the Internet of Things.

When the smartphone applications are ready, they will be available through the U4IoT tools website here: <http://u4iot.eu/u4iot-tools.html#44>

### HOW TO USE THE MOBILE APPLICATION

#### Installation

##### Google Play

1. Go directly to <https://play.google.com/store/apps/details?id=eu.iotlab.IoTLab> with your Web browser on your Android phone.
2. Click on the "Install" button.
3. Then, the application will be downloaded and installed automatically.

Other solution:

1. Open the application named "Play Store".
2. On the search bar, enter "iotlab" or "iot lab".

---

<sup>1</sup> <https://www.xamarin.com>



3. In the results list, click on the application named "IoT Lab" with "Mandat International" as publisher.
4. Then, click on the "Install" button.
5. Finally, the application will be downloaded and installed automatically.

### Apple Store

6. From the home-screen of your iPhone, first make sure you have access to about 40MB of mobile data or a wifi network and then select the icon labelled "App Store".
7. Using the store's search function, search for "iot lab".
8. Select the app featuring the same image as seen in Figure 1 and download the app.

### First use

After the successful installation of the mobile application on your smartphone, there are several steps to complete during your first use of the application. First of all, a welcome text is displayed and contains important information about the application, its goals and its features:

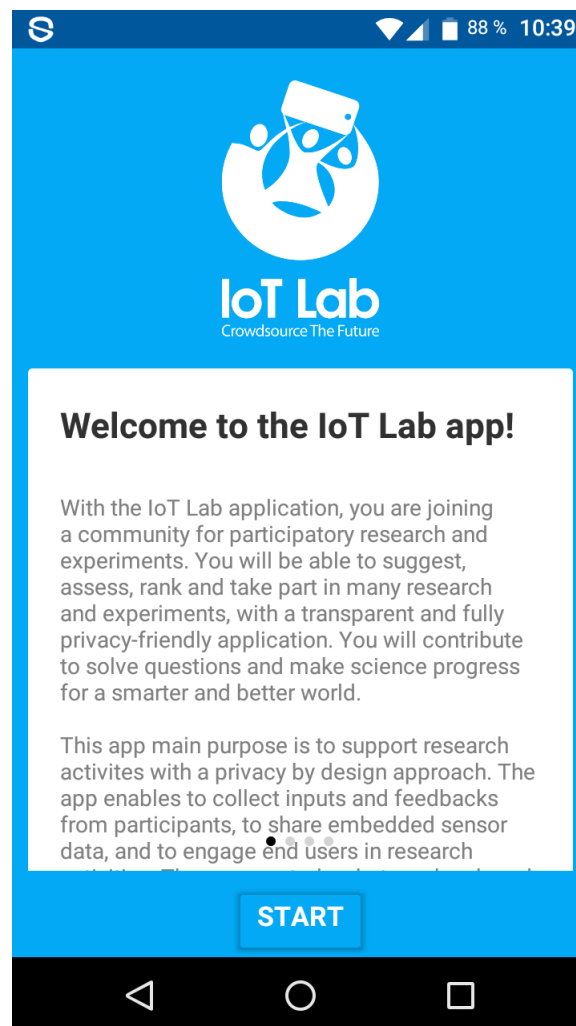


Figure 1: Welcome text

The second screen of the application shows the principles for privacy and the license agreement:

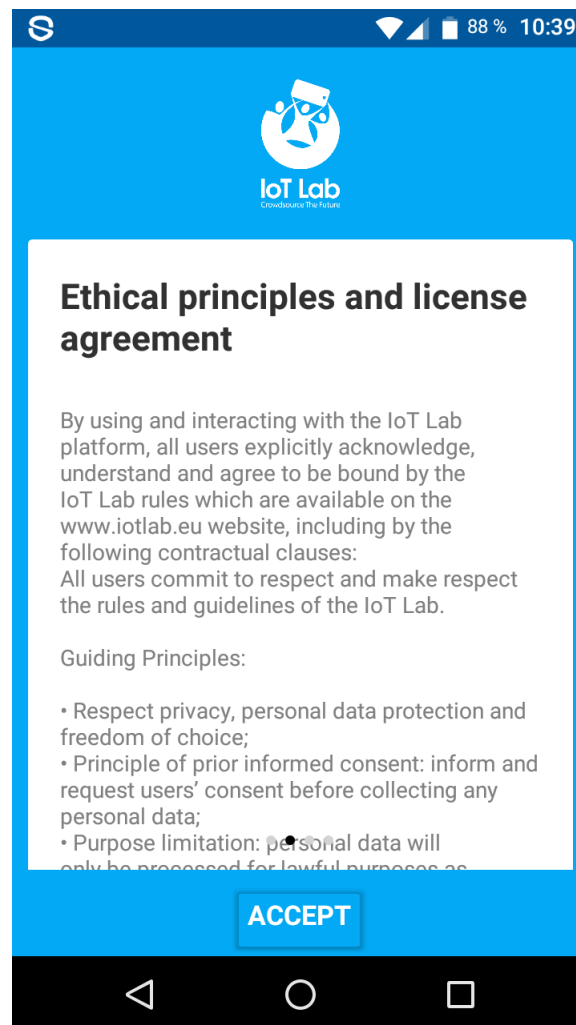


Figure 2: Ethical principles and license agreement

After accepting the license agreement, you set the parameters for data-sharing. The first setting concerns the data generated by the phone's sensors like the light sensor, the magnetometer, the accelerometer and the gyroscope. The second setting concerns the sharing of the phone's location data from sources such as GPS, GLONASS and, in the future, Galileo. Finally, you can select which domains are most interesting for you.

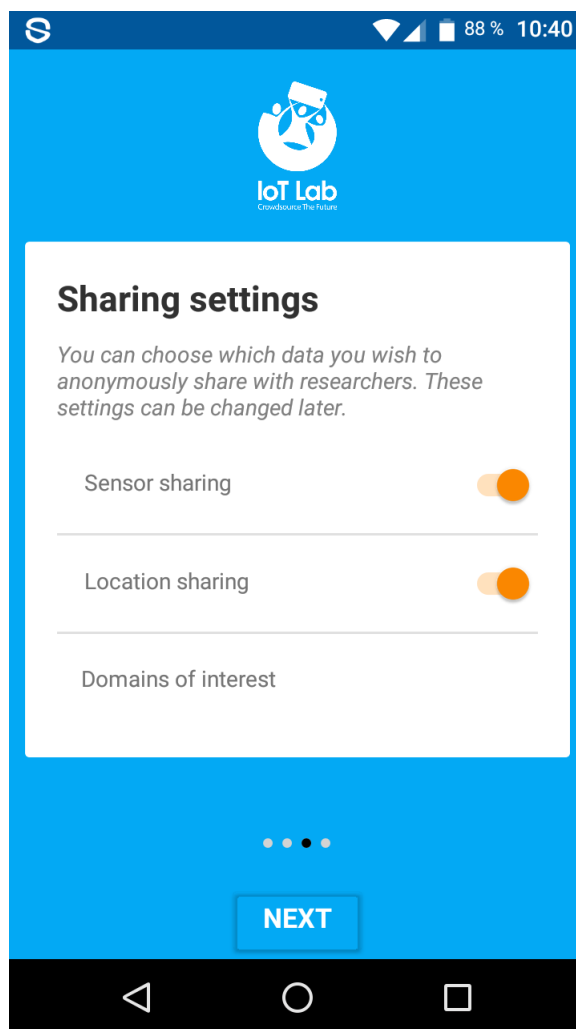
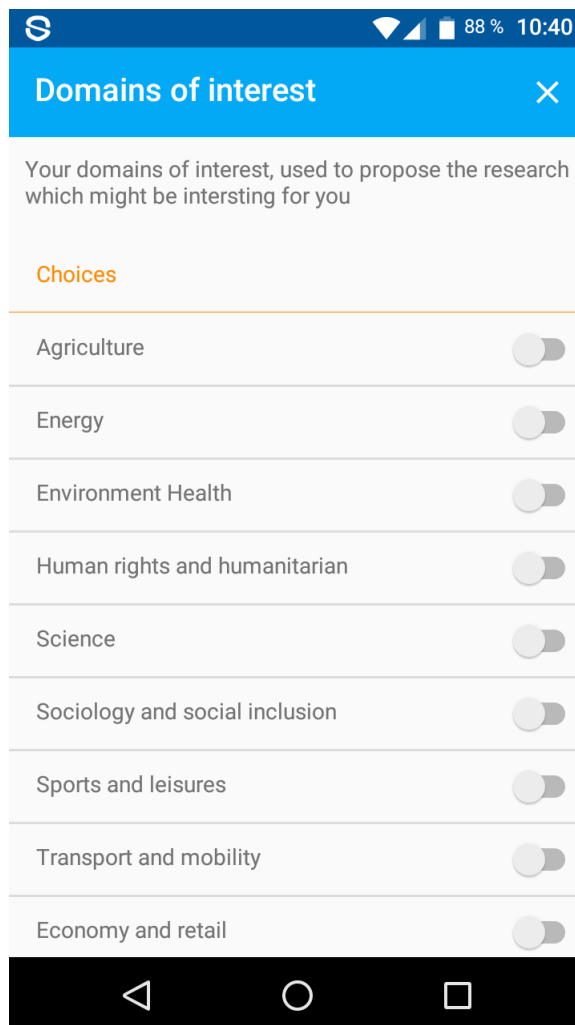


Figure 3: Sharing settings



**Domains of interest** ✕

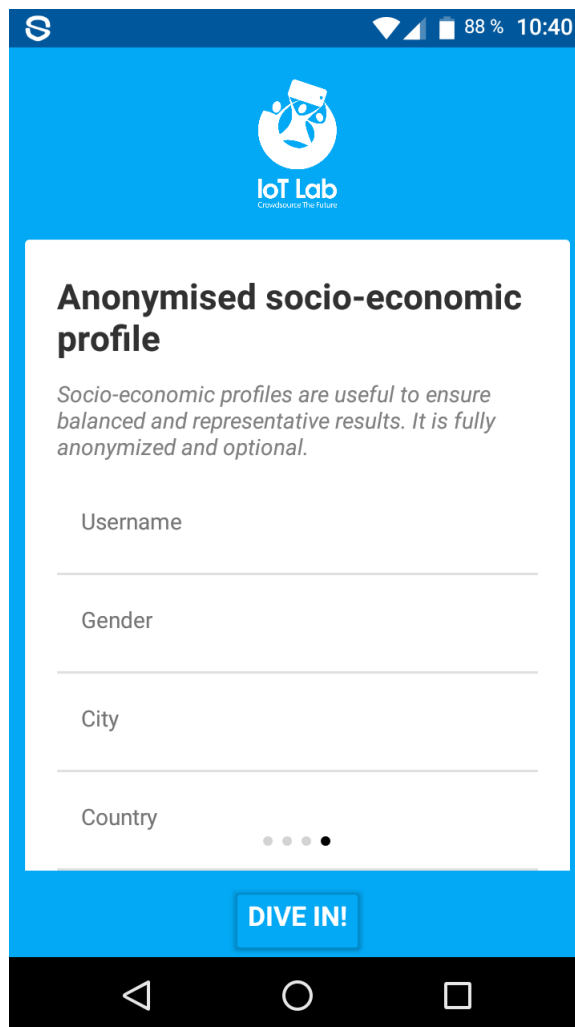
Your domains of interest, used to propose the research which might be interesting for you

**Choices**

Agriculture	<input type="checkbox"/>
Energy	<input type="checkbox"/>
Environment Health	<input type="checkbox"/>
Human rights and humanitarian	<input type="checkbox"/>
Science	<input type="checkbox"/>
Sociology and social inclusion	<input type="checkbox"/>
Sports and leisures	<input type="checkbox"/>
Transport and mobility	<input type="checkbox"/>
Economy and retail	<input type="checkbox"/>

Figure 4: Domains of interest for the user

The final part is the completion of your socio-economic profile, however, this is not mandatory and any data given by the user are fully anonymised. The goal of the socio-economic profile is to target specific users depending on particular socio-economic criteria. For example, if a research project or experiment is targeting older individuals, an age filter can be used to send a survey only to these people.



The screenshot shows a mobile application interface with a blue header. At the top, there is a status bar with a signal icon, Wi-Fi icon, battery level at 88%, and time at 10:40. Below the status bar is the IoT Lab logo, which consists of a circular icon with a person and a gear, and the text 'IoT Lab' and 'Crowdsource The Future'. The main content area is white and contains the title 'Anonymised socio-economic profile' in bold. Below the title is a paragraph of text: 'Socio-economic profiles are useful to ensure balanced and representative results. It is fully anonymized and optional.' There are four input fields: 'Username', 'Gender', 'City', and 'Country'. The 'Country' field has a dropdown arrow. Below the input fields is a blue button with the text 'DIVE IN!'. At the bottom of the screen is a black navigation bar with three icons: a back arrow, a circle, and a square.

Figure 5: Anonymised socio-economic profile

## Homepage

The following image shows the homepage of the mobile application:

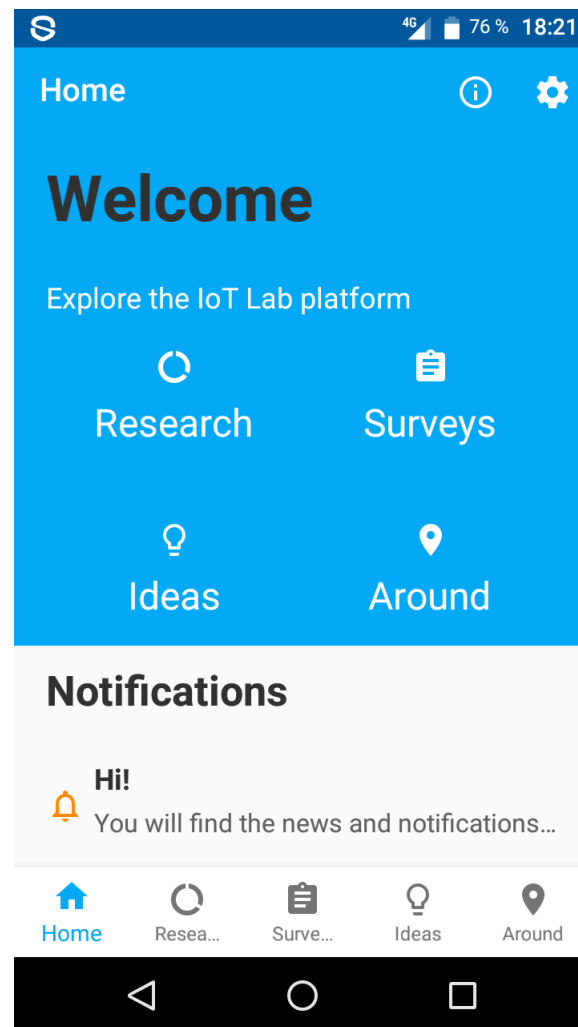


Figure 6: Homepage of the mobile application

The main screen of the mobile application is composed of four large buttons: “Research”, “Surveys”, “Ideas” and “Around”. Beneath these buttons, there is an area dedicated to notifications sent by the researchers who are managing the different research projects and experiments on the IoT Lab platform. For example, a notification sent by a researcher and then displayed on the application could be an announcement of a new survey linked to a research project in which the user is currently taking part. At the bottom of the screen, five buttons are permanently available to the user to navigate throughout the application and are the same as the four previously mentioned plus the “Home” button. Finally, on the top right of the homepage, two buttons, namely “About” and “Settings” respectively, provide information about the IoT Lab project and all the settings of the mobile application.

## Research

By clicking on the “Research” button, the user arrives at the list of all active research projects:

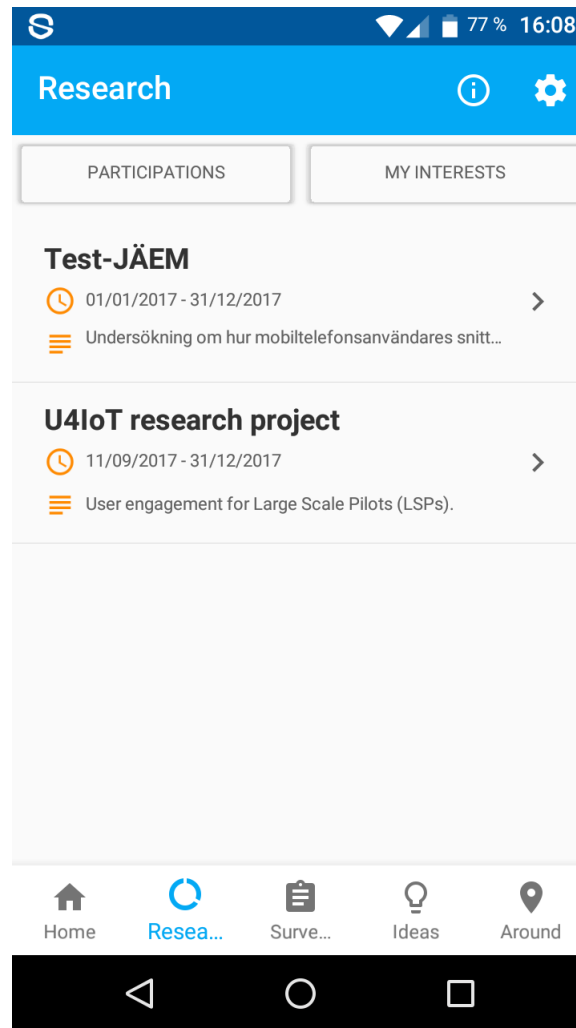


Figure 7: List of research projects

In addition to being able to see the entire list of research projects, they can be classified based on either the projects in which the user is participating or on the user's domains of interest. Two buttons ("Participations" and "My interests") at the top of the screen permit the desired classification - touching the button toggles the filter on and off. The following picture illustrates the classification by the user's participation: only the research project in which the user is currently enlisted is displayed:

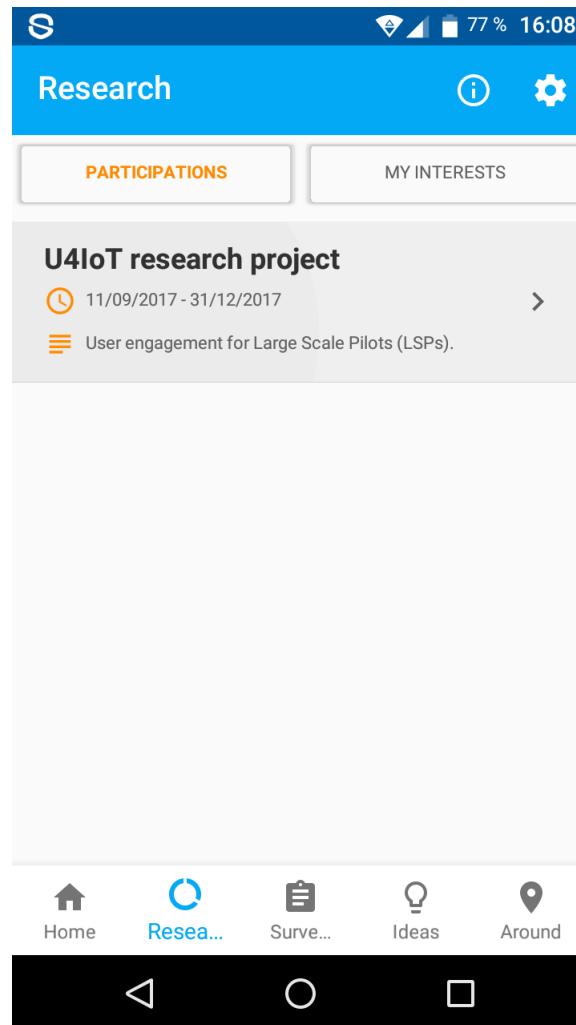


Figure 8: The research project in which the user is currently taking part

The user can select the desired research project to get all the details of this project as shown below:



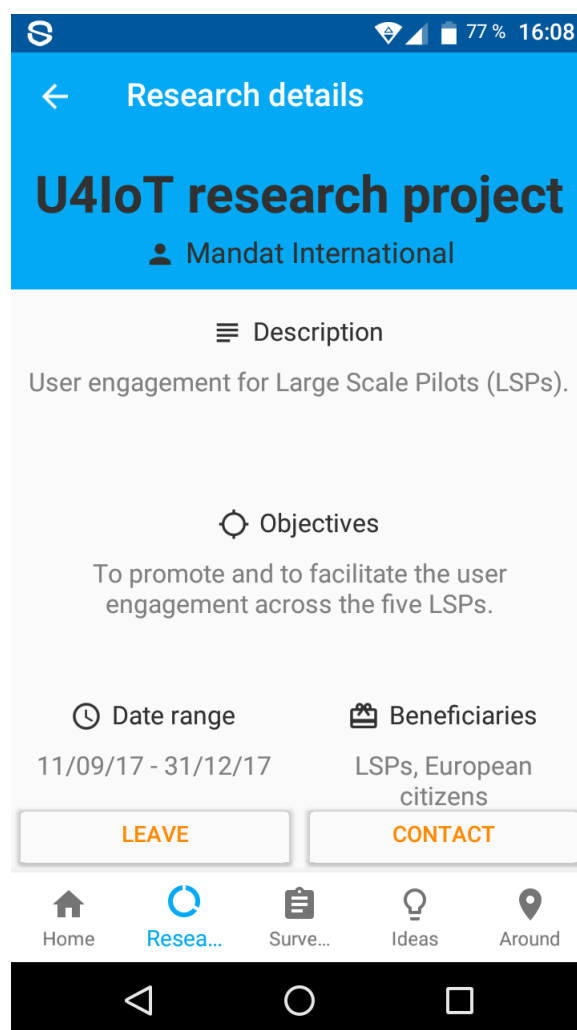


Figure 9: Details of a research project

The names of the research project and organisation leading the project are displayed at the top of the screen followed by the description and the objectives of the project underneath. The duration of the project is shown with the start and end dates as well as the beneficiaries of the project. A button “Enroll/Leave” permits the user to join or leave the project. A second button labelled “Contact” sends a message written by the user to the researcher. This message is sent anonymously.

When a participant is registering to take part in something arranged by an LSP, they will come to this part of the application and find the LSP’s research project once it’s been activated on the IoT Lab website. Detailed information regarding use of the website is given in Section 2.

## Surveys

The button “Surveys” leads to the list of current surveys available on the IoT Lab platform:

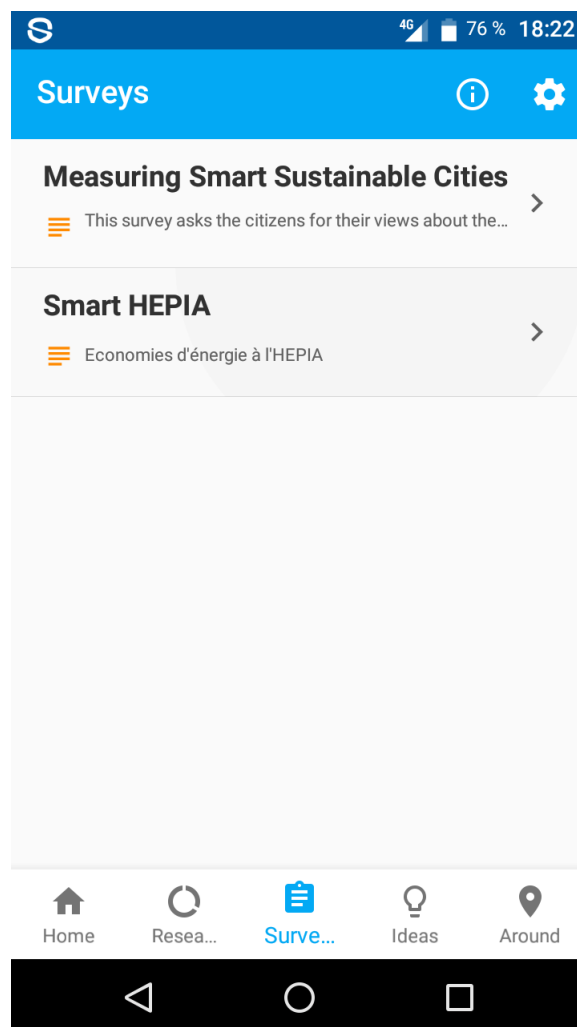
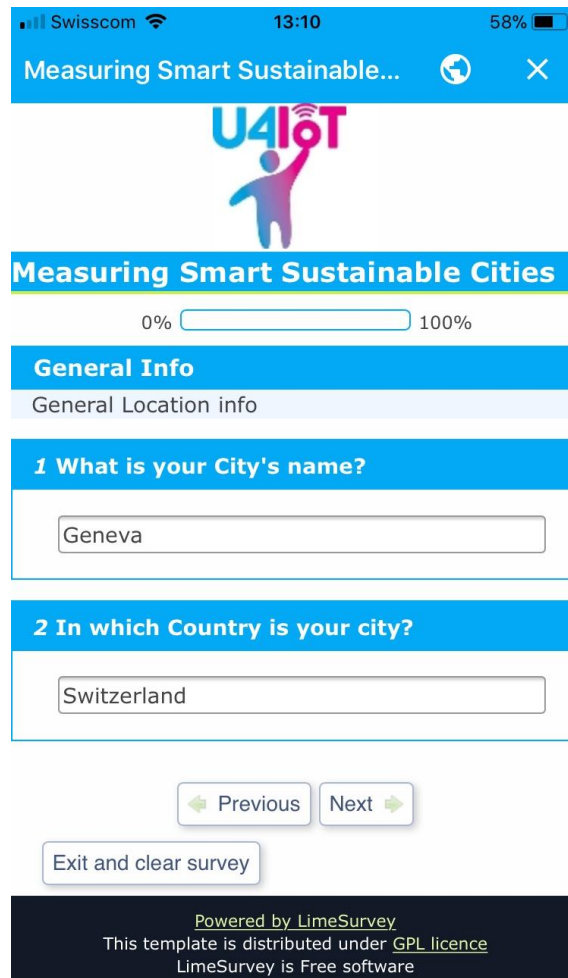


Figure 10: List of surveys

To access a survey, a simple click on the desired questionnaire is sufficient and the application shows the survey stored in the LimeSurvey server as displayed here:



The screenshot shows a mobile application interface for a survey. At the top, the status bar indicates 'Swisscom', signal strength, time '13:10', and battery level '58%'. The app title bar reads 'Measuring Smart Sustainable...' with a refresh icon and a close 'X' button. Below the title bar is the U4IoT logo. A progress bar shows '0%' to '100%'. The main content area has a blue header 'Measuring Smart Sustainable Cities'. Underneath is a section 'General Info' with a sub-header 'General Location info'. The first question is '1 What is your City's name?' with a text input field containing 'Geneva'. The second question is '2 In which Country is your city?' with a text input field containing 'Switzerland'. At the bottom, there are three buttons: 'Previous' (with a left arrow), 'Next' (with a right arrow), and 'Exit and clear survey'. A footer bar contains the text: 'Powered by LimeSurvey', 'This template is distributed under GPL licence', and 'LimeSurvey is Free software'.

Figure 11: Example of a survey

Surveys run through a dedicated server known as LimeSurvey and new surveys must be generated there. It features several templates and the default template has been changed to match the design of the crowdsourcing application. Since the surveys run remotely, at time of writing, it is not possible to complete surveys without some kind of data connection. However, the data requirements of the average survey are low. Full details on controlling the survey aspect of your crowdsourcing efforts are provided in Section 3.

## Ideas

The section “Ideas” on the mobile application permits each user to propose new ideas in any of the domains linked to the Internet of Things and to rate the ideas written by the other users.

The user can submit a new idea by touching the blue button with the “+” sign at the bottom of the screen as shown in the following picture:

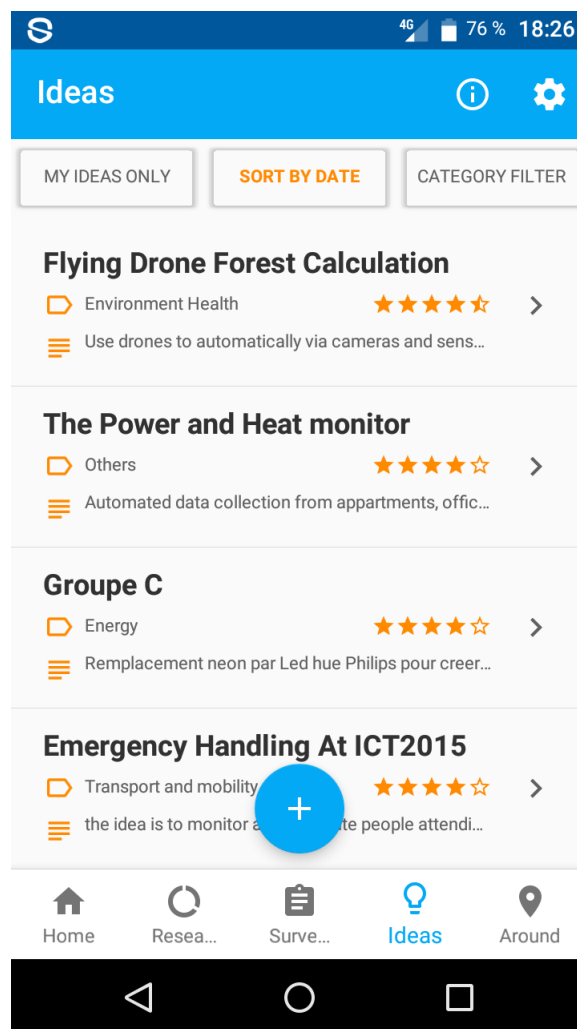
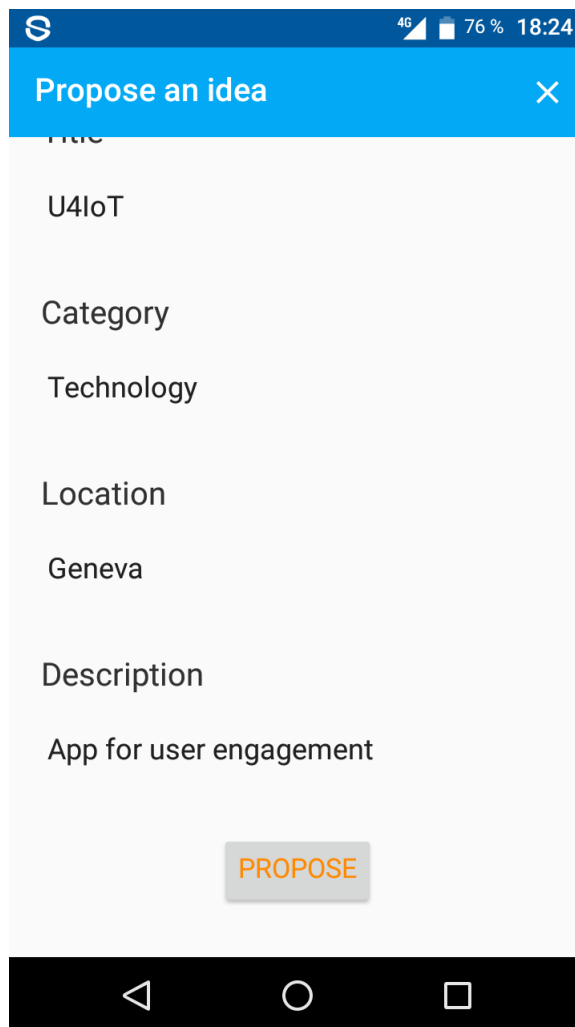


Figure 12: Button to propose a new idea

The user should enter the following information when proposing a new idea: a title, a category from the given list, the location and a description of the new idea. This is illustrated below:



S 4G 76 % 18:24

Propose an idea ×

Name

U4IoT

Category

Technology

Location

Geneva

Description

App for user engagement

PROPOSE

Figure 13: Propose a new idea

The ideas can be ranked by users' ratings, by the date of creation or by category. Additionally, the user can choose to see only his own ideas. The necessary buttons are available at the top of the screen. The following image shows the ideas proposed by the user himself and no ideas submitted by other users:

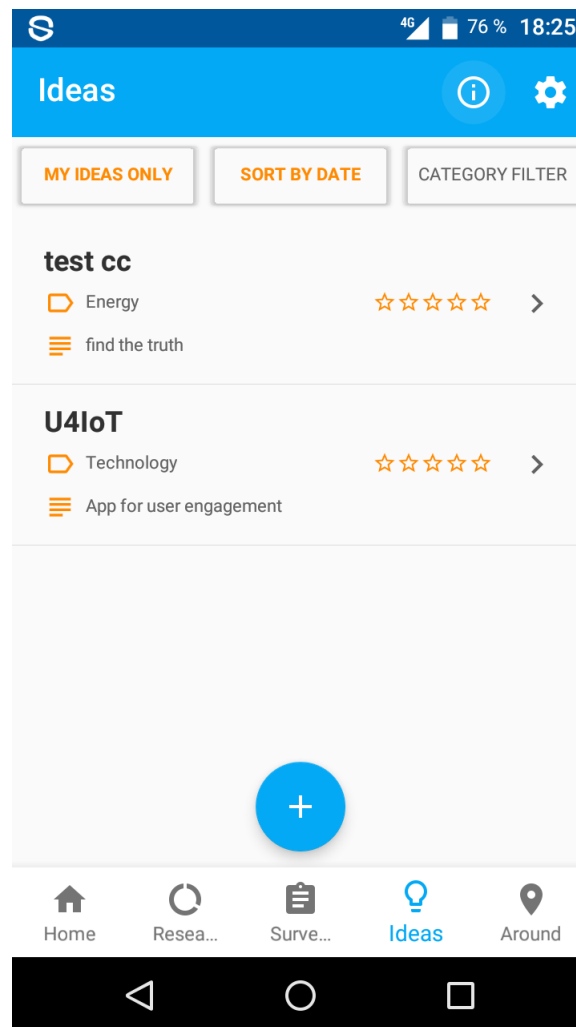


Figure 14: Ideas proposed by the owner of the phone

The following picture shows the ideas ranked according to the votes made by IoT Lab users:

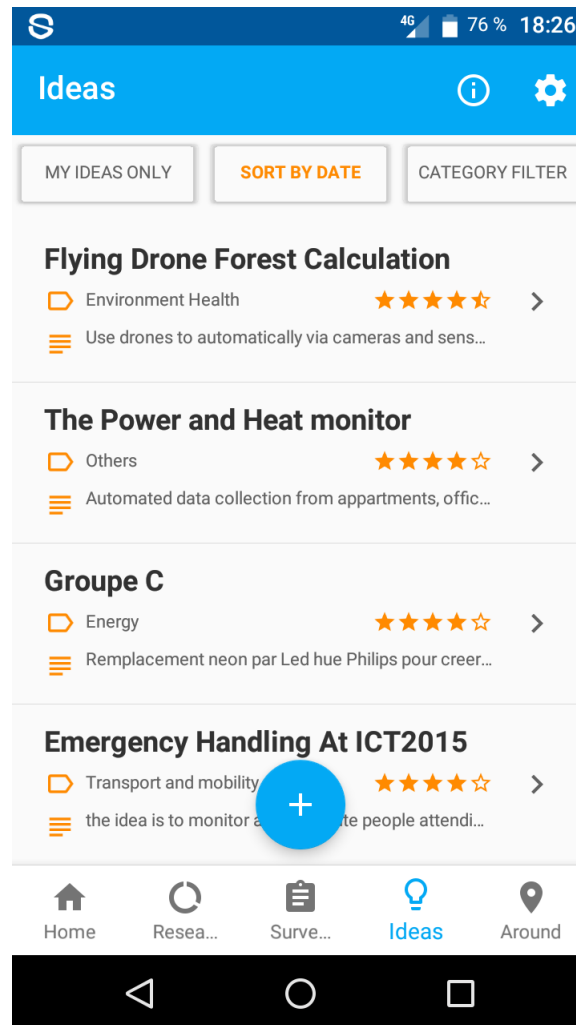


Figure 15: Ideas ranked by rating

As mentioned earlier, the following image illustrates the classification of all ideas by date of creation:

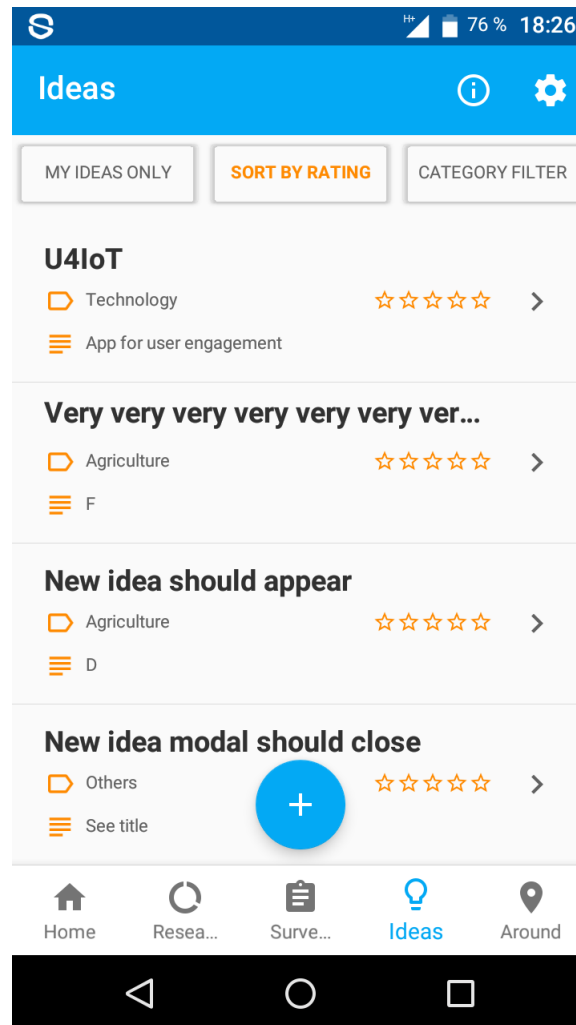


Figure 16: Ideas ranked by date

The ideas can also be ranked by category. For example, the category “Technology” was selected and the corresponding result is:



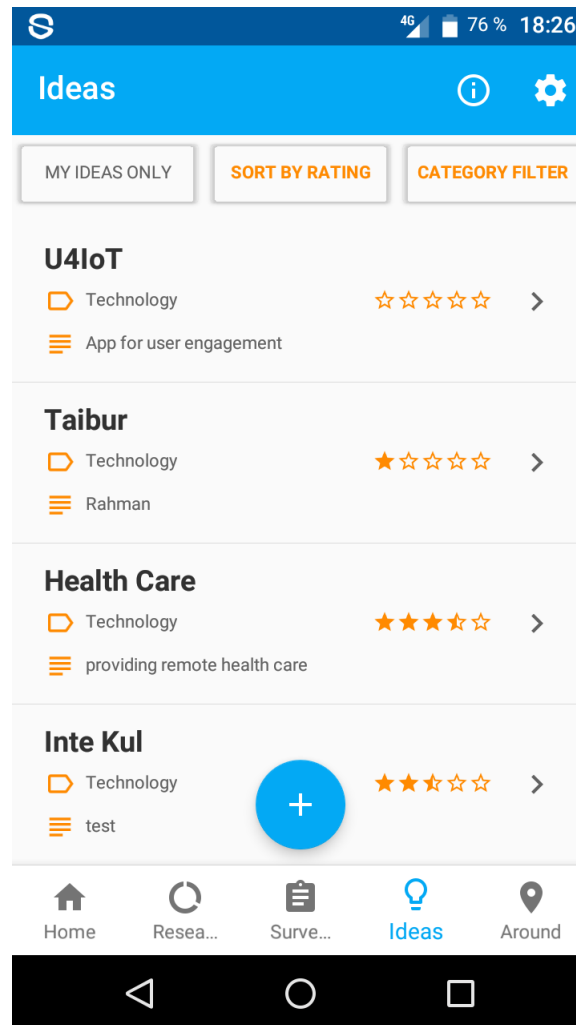


Figure 17: Ideas ranked by category

Each idea can be rated by the users of the IoT Lab platform. The process of rating is simple: click on the desired idea and it appears on-screen like this:

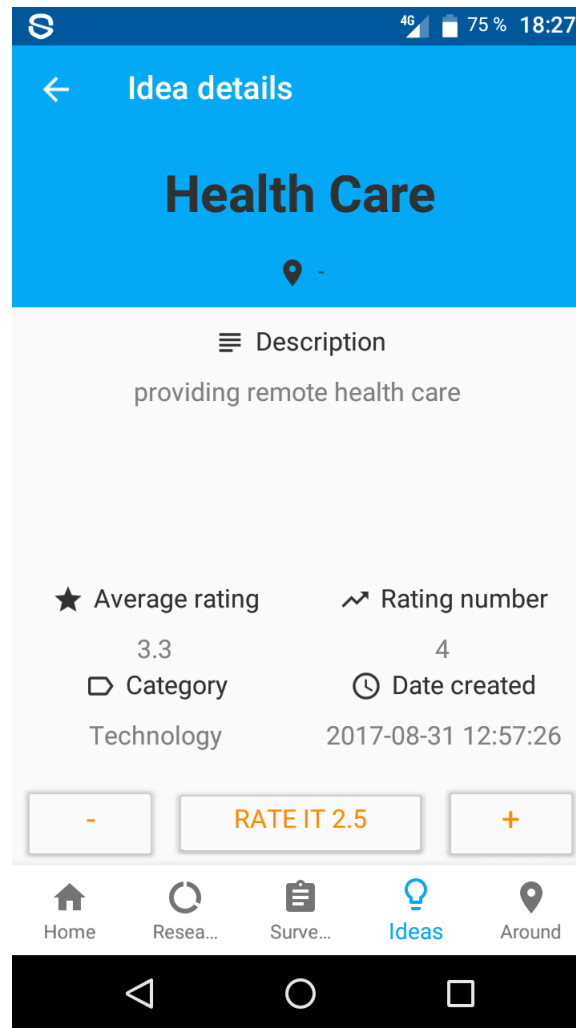


Figure 18: An example of an idea

The idea is composed of a title ("Health Care", for instance), a description, the average rating (e.g. "3.3"), the number of votes (e.g. "4"), the category ("Technology", for instance), the date and the time of creation. Then, three buttons are used to rate this idea. The left button decreases the current value of the rating displayed on the central button ("2.5" in the example) and the right button increases the value of the rating. When the user is happy with the value of the rating shown in the central button, the user submits his rating by clicking on the central button. The user cannot rate his own ideas - the central button is disabled as shown in this illustration:

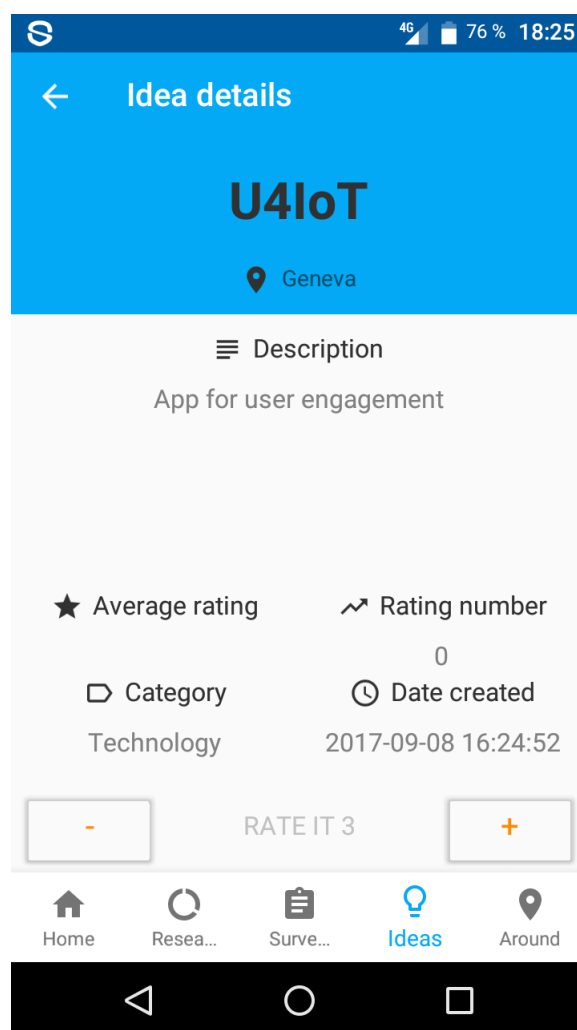


Figure 19: User's idea

The LSPs can use this feature to get new ideas from their end-users and see in an intuitive way what's popular and what's not. It also gives the LSP partners an opportunity to throw out their own ideas and see which ones get the most traction.

### Around

The “Around” part of the IoT Lab mobile application displays a map showing all the resources available in the vicinity of the user's phone. To work correctly, localisation must be enabled on the user's phone. Clicking on a pin on the map displays some information about the resource:

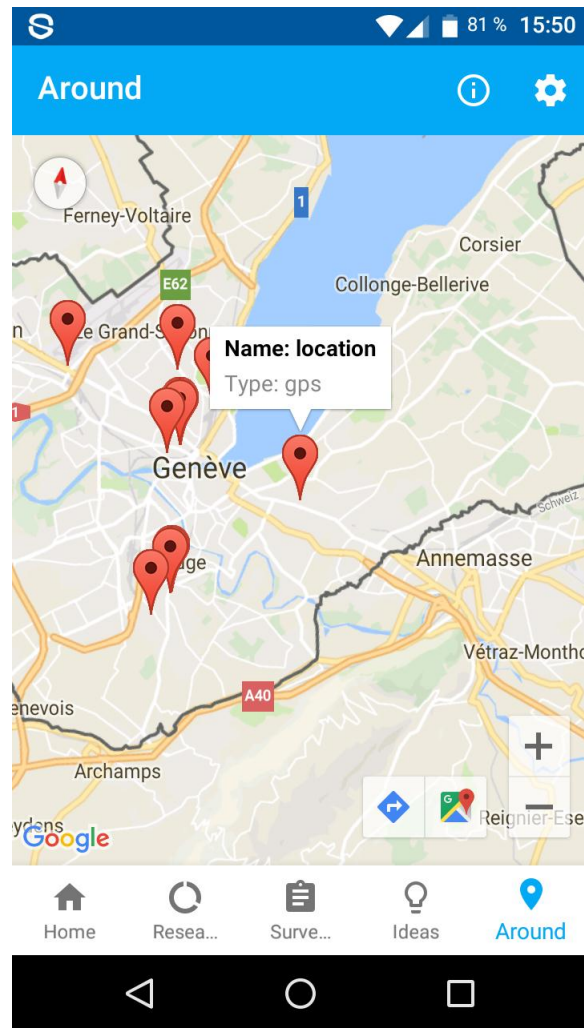


Figure 20: A resource on the map

Future iterations of this feature will show more information about the various IoT devices.

## Notifications

The researchers can send notifications to phones to make users aware of new surveys, research activities involving the users themselves and more. On iOS, users need to expressly allow notifications on the main screen in their phone's settings. The notifications are displayed on the main page of the mobile application at the bottom of the screen:

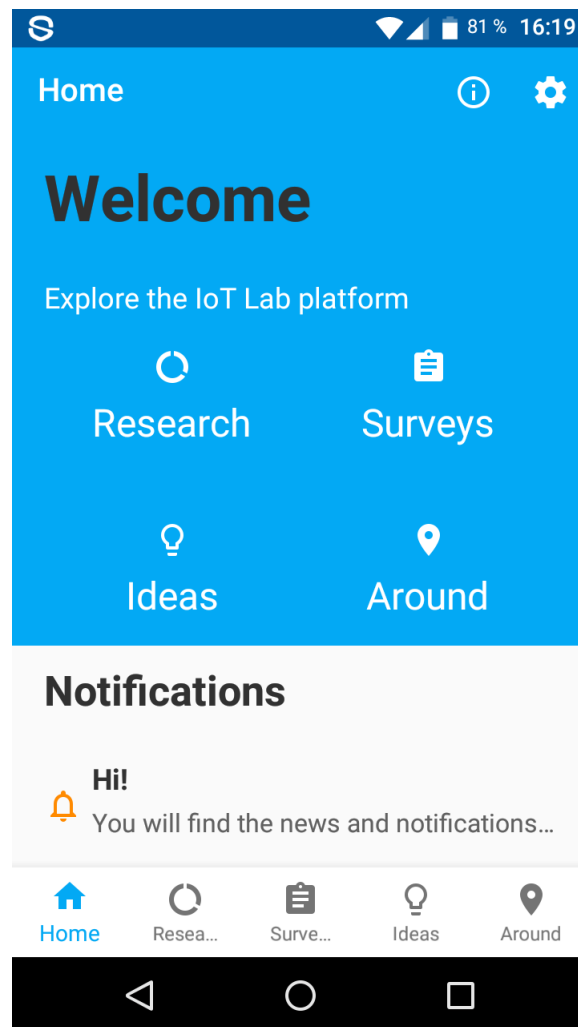


Figure 21: Notifications on the homepage

By clicking on a notification, a pop-up window will appear on the screen of the phone. This window contains the title of the notification and the notification's text:

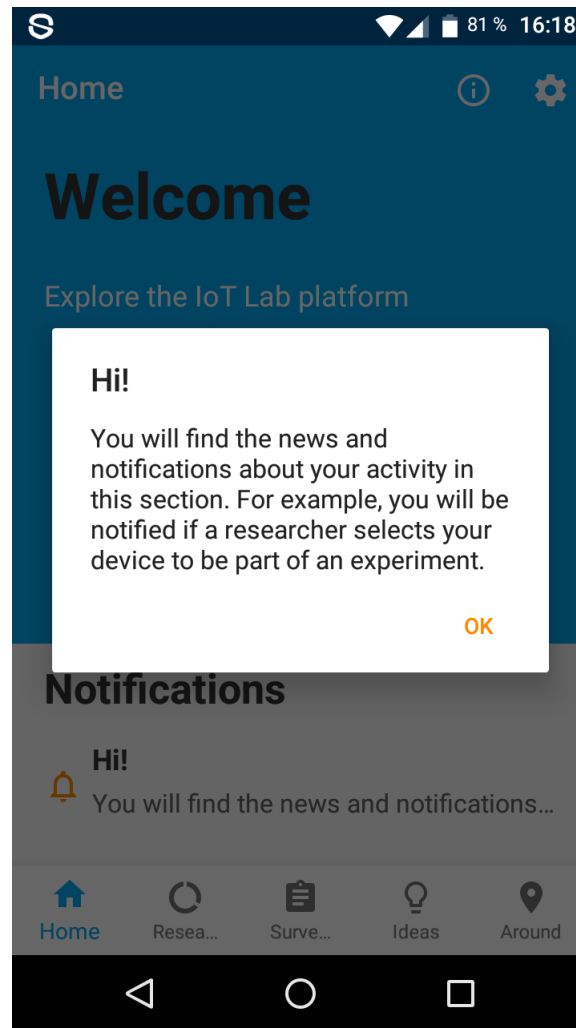


Figure 22: Notification

## About

The information concerning the IoT Lab platform is available by clicking the corresponding button at the top-right of the application. The icon of this button contains an “i” sign.

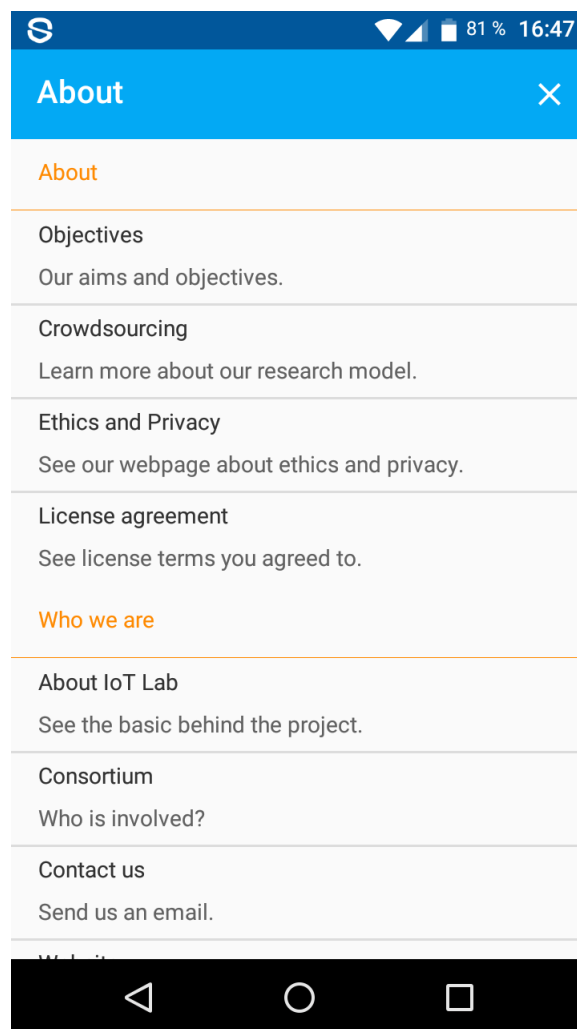


Figure 23: About

The “About” section presents all the information related to the IoT Lab platform and the mobile application described in this document. The objectives, the principles of crowdsourcing, the ethics, privacy and license agreement are all explained in the first part of the “About” page. Afterwards, the IoT Lab project, now an association, is presented, in particular the consortium, notably through links leading to the IoT Lab website at <http://www.iotlab.eu>. The user can contact the IoT Lab association by email from the “About” part of the application. It is also possible for the user to delete his account from this page.

## Settings

The settings are reachable from any page in the application by clicking on the button resembling a cog-wheel at the top-right of the screen. The page is displayed here:

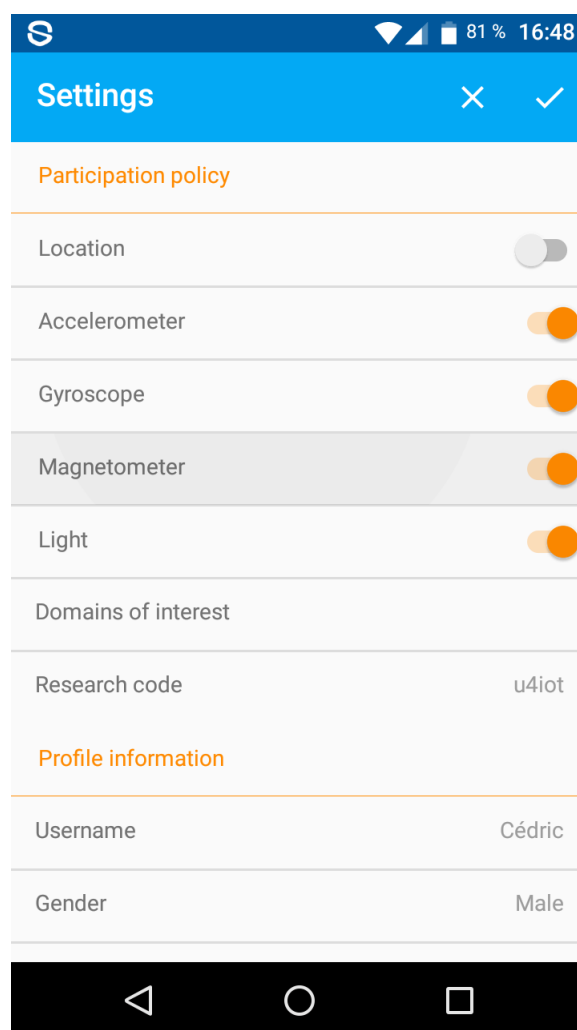


Figure 24: Settings

First of all, the permissions to use the smartphone's sensors inside the mobile application can be changed by the user. If the permission of a sensor is not granted by the user, no data provided by this sensor can be collected or sent to the IoT Lab platform. The user can also modify his domains of interest which had been previously chosen during their first use of the mobile application. A research code can be entered by the user to participate in research projects using this feature. The principle of the research code will be explained later in the chapter dedicated to the IoT Lab website. Finally, the socio-economic profile provided by the user at the beginning can be completely modified; the personal data composing the user's profile are anonymised and securely stored to ensure adequate data privacy.



## SECTION 2: THE WEBSITE

### INTRODUCTION

The IoT Lab website (<http://www.iotlab.eu>) permits researchers to interact with the users of the mobile application. There are two main methods for involving the crowd in research projects run via the IoT Lab platform: either using the surveys or the sensors installed on the smartphones. The sensors, which are part of IoT, are handled via the website and how one interacts with them is described in this chapter.

### HOW TO USE THE WEBSITE

#### Registration on the website

First of all, the user of the IoT Lab platform needs to be registered by completing the form at this address: <http://www.iotlab.eu/Account/Login>. The mandatory fields of the form are: the role of the user, their username, their email address and their password. Four roles are available for the user: researcher, testbed owner, sponsor and charity. The researcher is the main user of the IoT Lab website and creates research projects and experiments using all the resources provided by the IoT Lab platform such as the sensors and actuators installed in the different testbeds across Europe, the smart phones and the surveys. The testbed owner makes the resources (sensors and actuators), which are available on his testbed, available to the IoT Lab platform. The sponsor can fund or support the platform. The charity can receive donations from users of the IoT platform. In this document, the features available to the U4IoT researchers are fully explained as the other roles are not relevant in the frame of the U4IoT project.

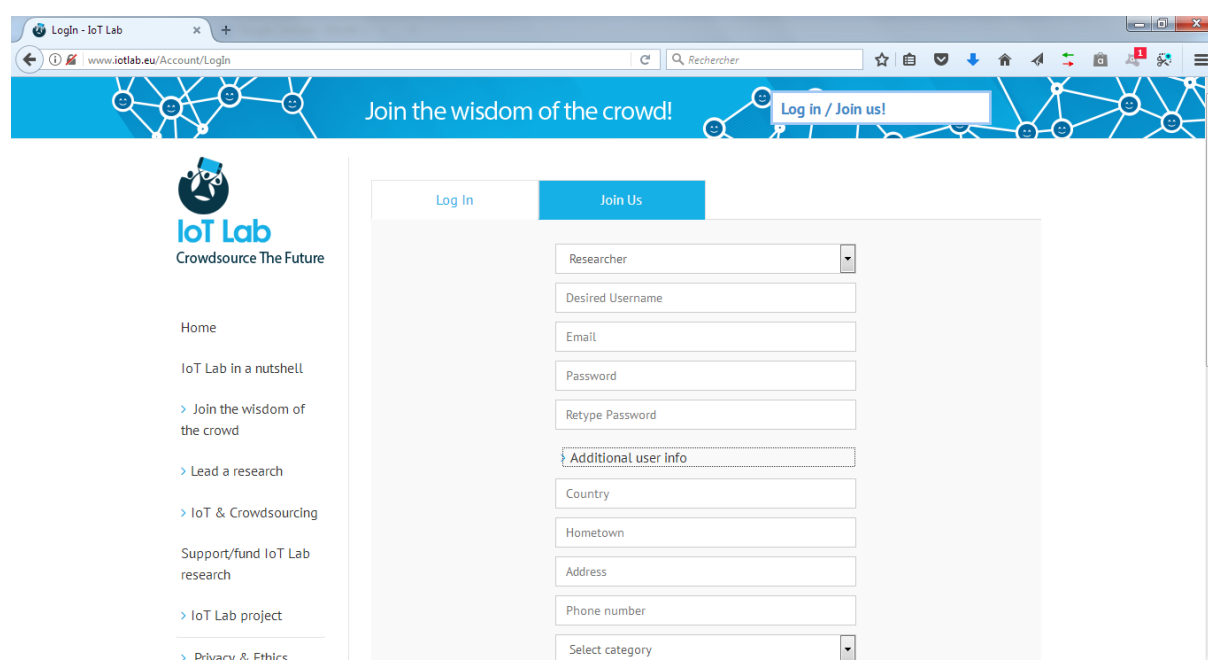


Figure 25: Form to be completed by a new user

Next, the user can complete other non-mandatory fields like country, hometown, address, phone number, category (academic, industrial, other), a public pseudonym, a short CV, the domain of research and the organisation. Once the user's registration has been approved by the IoT Lab platform administrator, the new researcher can connect to the website and begin his IoT-research project.

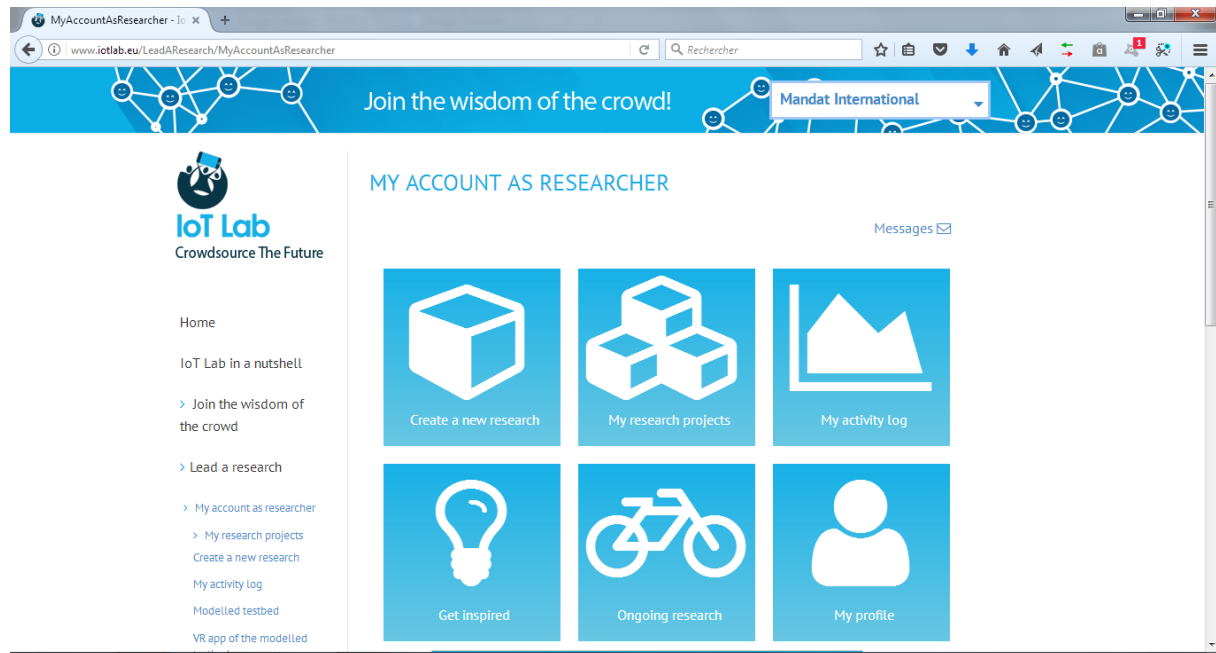
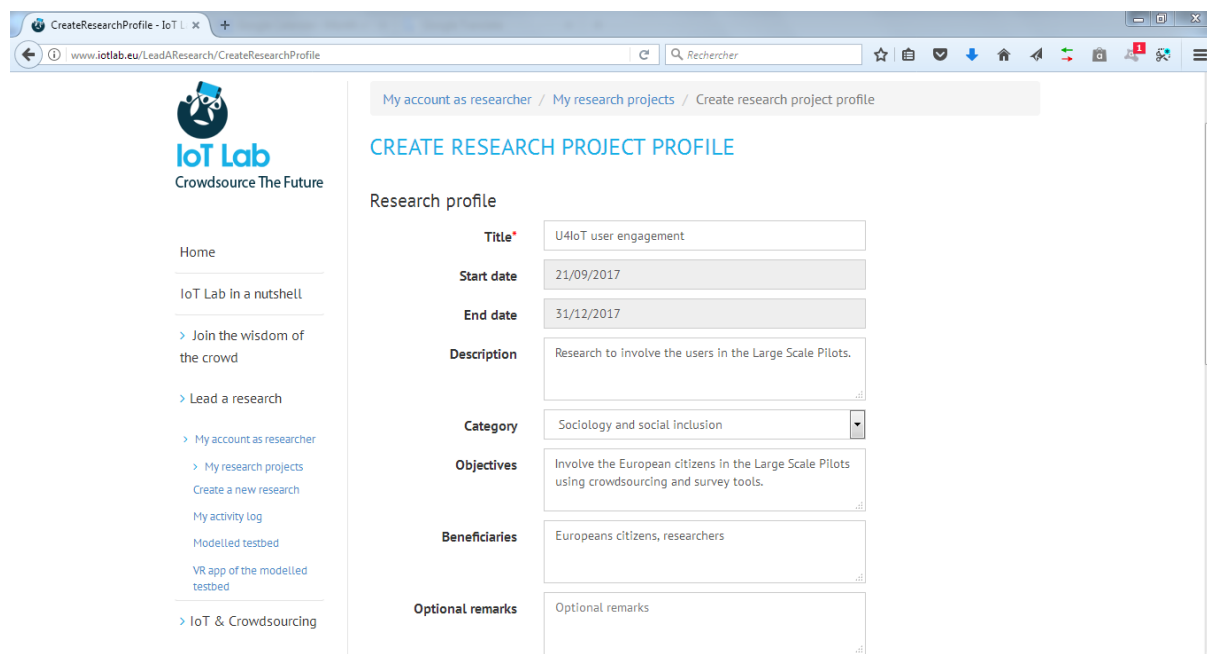


Figure 26: Main page for the researcher

## Create a new research project

First of all, the new researcher must create a new research project before creating any experiments with the resources of the IoT Lab platform. They click on the button "Create a new research project" on the main page of their account. A new form appears and must be completed by the researcher. This form corresponds to the profile of the research project as shown in the following screenshot:



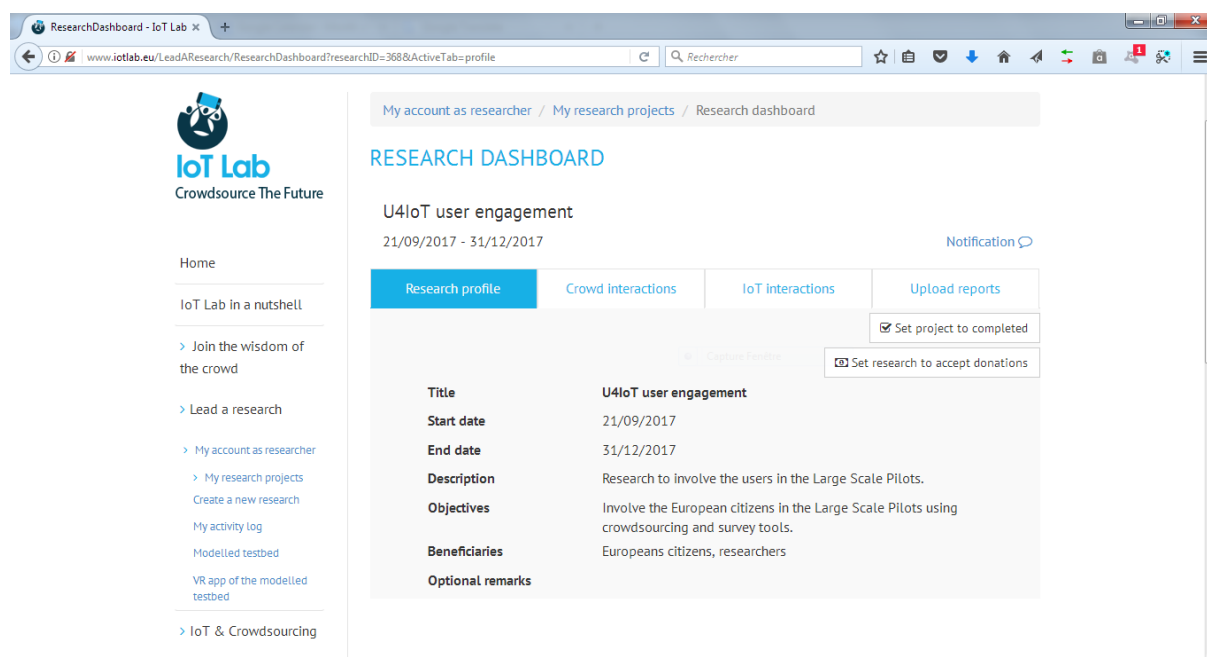
The screenshot shows a web browser window with the URL [www.iotlab.eu/LeadAResearch/CreateResearchProfile](http://www.iotlab.eu/LeadAResearch/CreateResearchProfile). The page title is "CREATE RESEARCH PROJECT PROFILE". The left sidebar contains the IoT Lab logo and navigation links: Home, IoT Lab in a nutshell, Join the wisdom of the crowd, Lead a research, My account as researcher, My research projects, Create a new research, My activity log, Modelled testbed, VR app of the modelled testbed, and IoT & Crowdsourcing. The main content area is titled "Research profile" and contains the following fields:

- Title\***: U4IoT user engagement
- Start date**: 21/09/2017
- End date**: 31/12/2017
- Description**: Research to involve the users in the Large Scale Pilots.
- Category**: Sociology and social inclusion
- Objectives**: Involve the European citizens in the Large Scale Pilots using crowdsourcing and survey tools.
- Beneficiaries**: Europeans citizens, researchers
- Optional remarks**: Optional remarks

Figure 27: Form for a new research project

The profile of a research project contains different parts: a title, a start date, an end date, the description of the research project, the objectives of the project, the beneficiaries and finally, optional remarks. Only the title of the project is mandatory.

After saving the profile, the corresponding research dashboard is displayed on the screen:



The screenshot shows a web browser window with the URL [www.iotlab.eu/LeadAResearch/ResearchDashboard?researchID=368&ActiveTab=profile](http://www.iotlab.eu/LeadAResearch/ResearchDashboard?researchID=368&ActiveTab=profile). The page title is "RESEARCH DASHBOARD". The left sidebar is identical to the previous figure. The main content area displays the project details for "U4IoT user engagement" (21/09/2017 - 31/12/2017). The dashboard includes a "Notification" link and a "Research profile" tab. The project details are as follows:

- Title**: U4IoT user engagement
- Start date**: 21/09/2017
- End date**: 31/12/2017
- Description**: Research to involve the users in the Large Scale Pilots.
- Objectives**: Involve the European citizens in the Large Scale Pilots using crowdsourcing and survey tools.
- Beneficiaries**: Europeans citizens, researchers
- Optional remarks**: Optional remarks

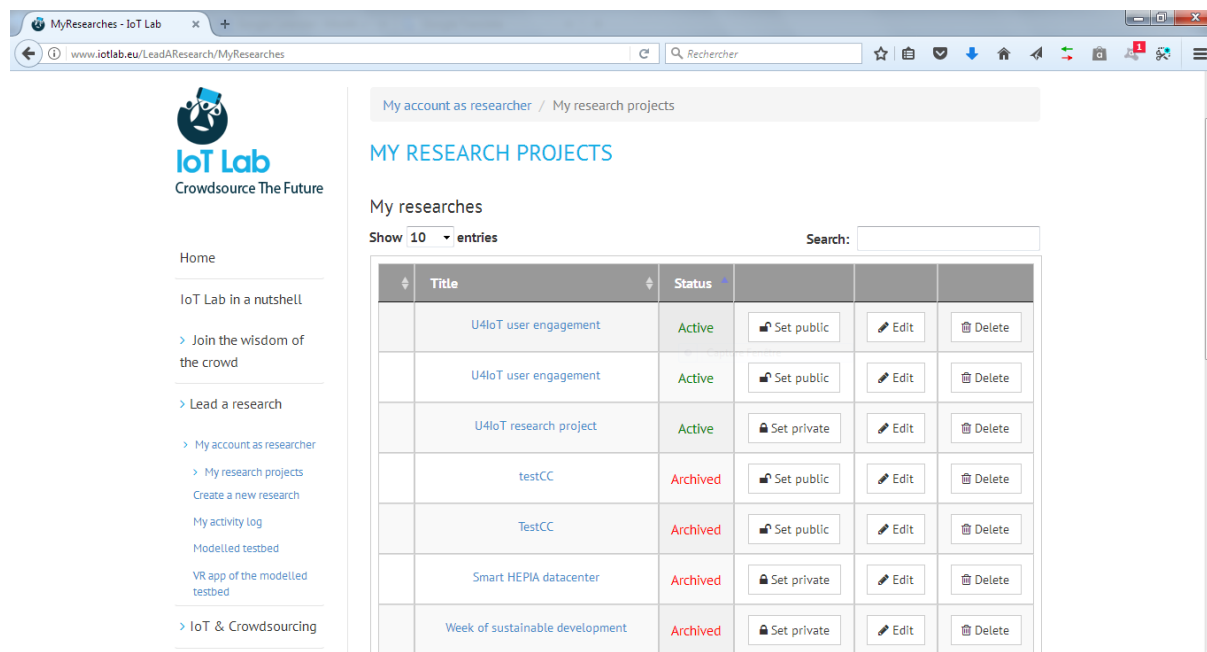
Additional options on the dashboard include "Crowd interactions", "IoT interactions", "Upload reports", "Set project to completed", and "Set research to accept donations".

Figure 28: Research dashboard

All the information entered previously by the researcher is shown in the web browser.

## My research projects

When the researcher has clicked on the “My research projects” button on the main page, a list of all their research projects are displayed like this:



The screenshot shows the 'My research projects' page in the IoT Lab system. The page has a sidebar with navigation links and a main content area. The main content area displays a table of research projects.

Title	Status	Actions
U4IoT user engagement	Active	Set public, Edit, Delete
U4IoT user engagement	Active	Set public, Edit, Delete
U4IoT research project	Active	Set private, Edit, Delete
testCC	Archived	Set public, Edit, Delete
TestCC	Archived	Set public, Edit, Delete
Smart HEPIA datacenter	Archived	Set private, Edit, Delete
Week of sustainable development	Archived	Set private, Edit, Delete

Figure 29: Research projects

The title of each research project is put on a row followed by its status (active or archived), a button making the research project public or private, a button to edit the profile of the research project and a button to erase the project. Projects are not visible on the crowdsourcing application unless they are both active and set as public.

The researcher can access a particular research project by clicking on its title and the following web page appears corresponding to the research project's dashboard:

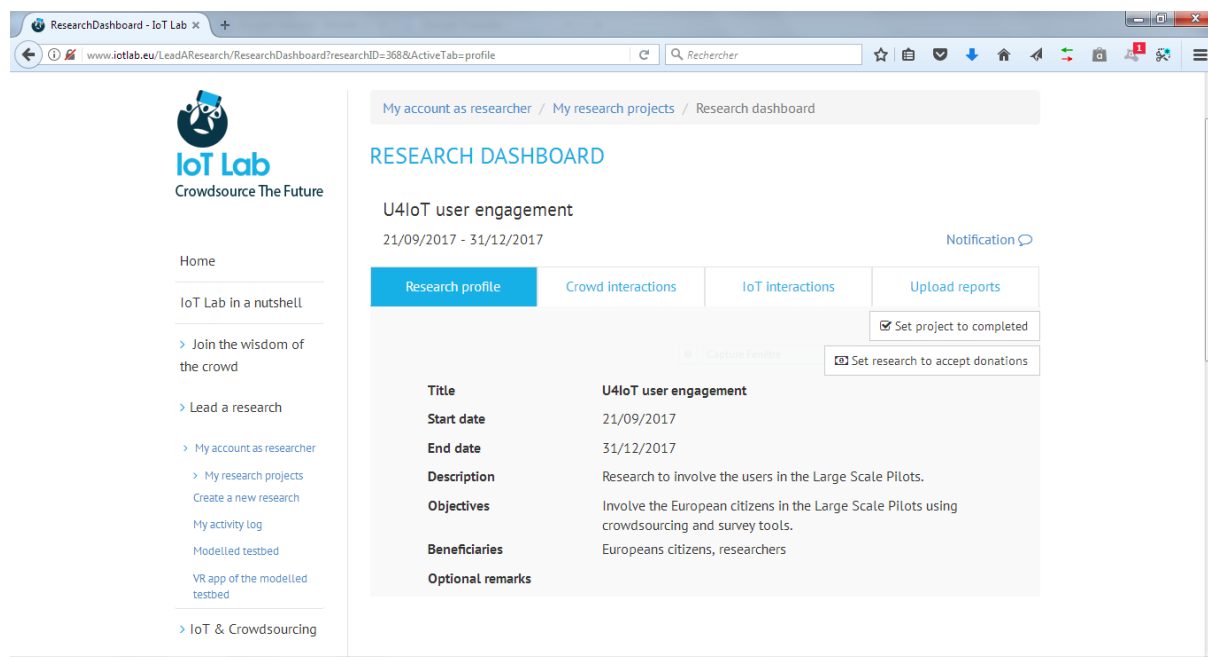


Figure 30: Dashboard of a research project

The first tab of the research dashboard shows all the information about the research project's profile as illustrated above. The second tab is used for the crowd interaction through surveys and will be explained in Section 3. The third tab concerns IoT interactions, reservation of resources and the creation of experiments. The following image illustrates the content of this tab:

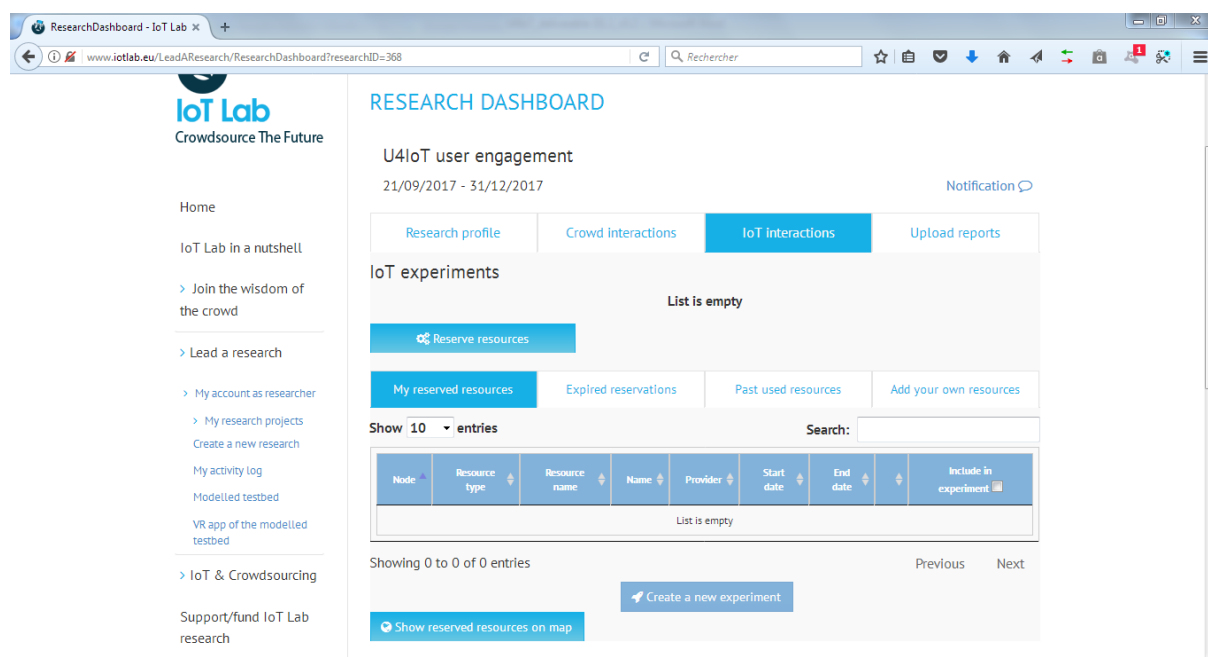
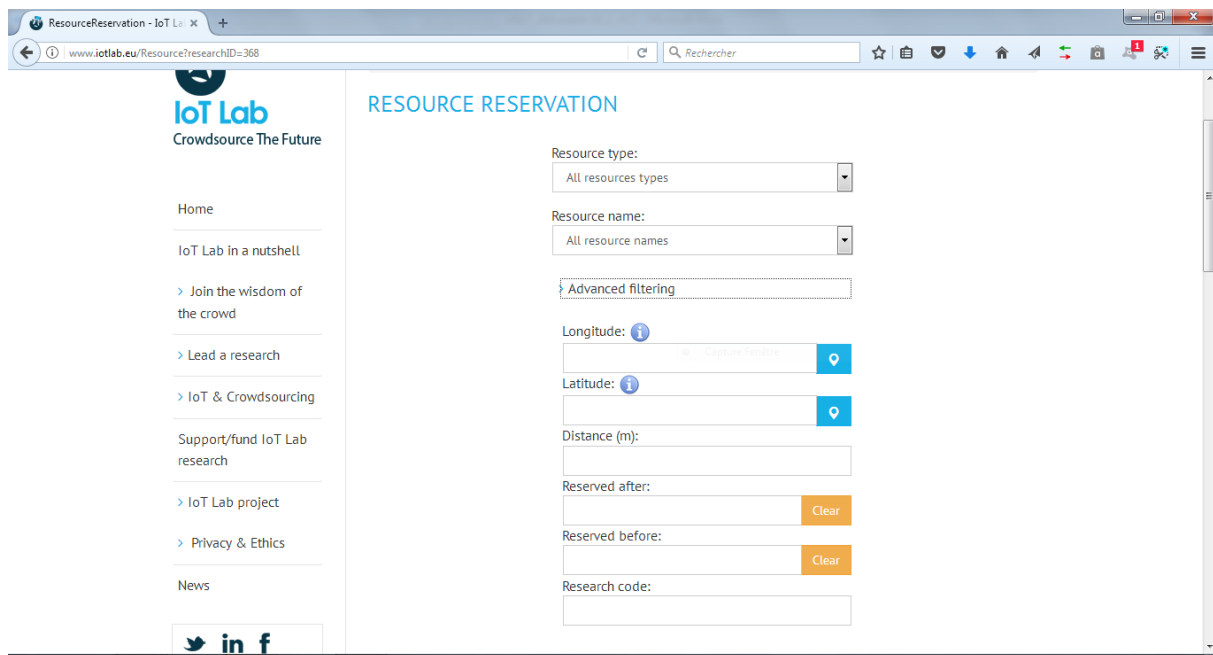


Figure 31: IoT interactions

## Resources reservation

To reserve the required resources, the researcher clicks on the “Reserve resources” button on the “IoT interactions” tab and gets this:



The screenshot shows a web browser window with the URL [www.iotlab.eu/Resource?researchID=368](http://www.iotlab.eu/Resource?researchID=368). The page is titled "RESOURCE RESERVATION" and features a sidebar for "IoT Lab" with navigation links: Home, IoT Lab in a nutshell, Join the wisdom of the crowd, Lead a research, IoT & Crowdsourcing, Support/fund IoT Lab research, IoT Lab project, Privacy & Ethics, and News. The main content area contains a form with the following fields:

- Resource type: A dropdown menu currently showing "All resources types".
- Resource name: A dropdown menu currently showing "All resource names".
- Advanced filtering: A button to expand the filtering options.
- Longitude: A text input field with an information icon and a location pin button.
- Latitude: A text input field with an information icon and a location pin button.
- Distance (m): A text input field.
- Reserved after: A text input field with a "Clear" button.
- Reserved before: A text input field with a "Clear" button.
- Research code: A text input field.

Figure 32: Resource reservation

The resources are sorted by resource type and resource name. The possible resource types are: device, general purpose I/O, power, load control, sensor, light control, message and location. All the information concerning the resource types is provided at the testbed level. The resource names correspond to the properties of the different IoT devices installed in the different testbeds like sensors and actuators, but also smartphones which are considered to be mobile IoT sensors.

The advanced filtering is composed of three features: geo-fencing, reservation dates and research code. Geo-fencing permits the reservation of every type of resource (IoT sensors and actuators, but also mobile phones with the IoT Lab application installed) in a particular geographic area. To achieve this, the researcher needs to enter a location given by its longitude and latitude. To help the researcher, a button similar to a pin is available. When it is clicked, a map appears and the researcher can put a pin on this map in the desired location. After submitting the location, the longitude and the latitude are automatically entered in the two corresponding fields of the form. The researcher then only needs to complete the process of the geo-fencing by writing a distance in meters. All the resources in the given distance from the defined location will be displayed on the list of available resources and any resources that are too far away will be ignored.

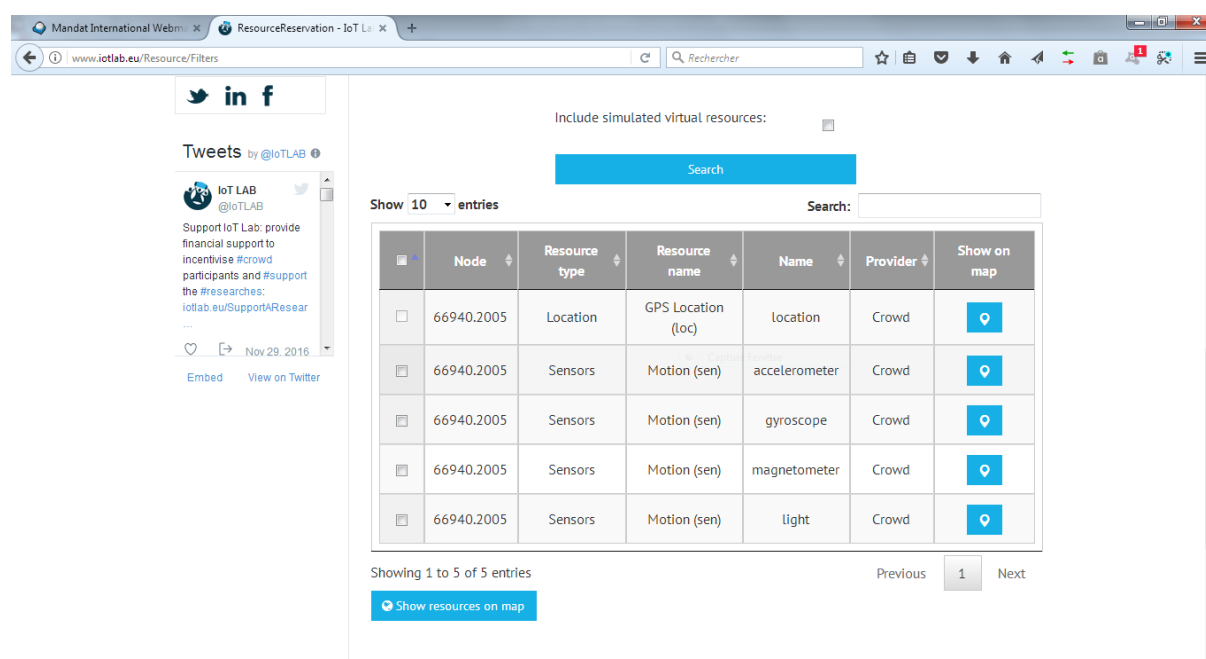
The second feature permits the reservation of resources during a given period of time using the “Reserved after” and “Reserved before” fields.

Finally, the research code, also named the project code, is given by the researcher and only the resources with this code are shown in the list of resources. Typically, the researcher defines a research/project code and shares it with the users who have

already installed the IoT Lab application on their smartphones; the users need to write this code in the settings of the mobile application. The code is a good way of identifying smartphones from the other IoT Lab resources when preparing new experiments. At the same time, the smartphones using a project code don't appear in the list of all available resources and so can be considered as a kind of private resource across the IoT Lab platform.

The research code is likely to be the primary method for LSPs to organise their crowdsourcing efforts. The LSP simply needs to ensure that their crowdsourcing participants have joined the LSP's research project on the application and entered the pre-agreed code (which can be any combination of alphanumeric characters) in the application settings. The LSP then simply needs to enter the exact same code in the advanced filtering section and the smartphone sensors of the participants will appear.

After entering all the desired criteria in the form, the user launches the resource search using the "Search" button and then a list of available resources is displayed. The following example shows the resources of a smartphone:



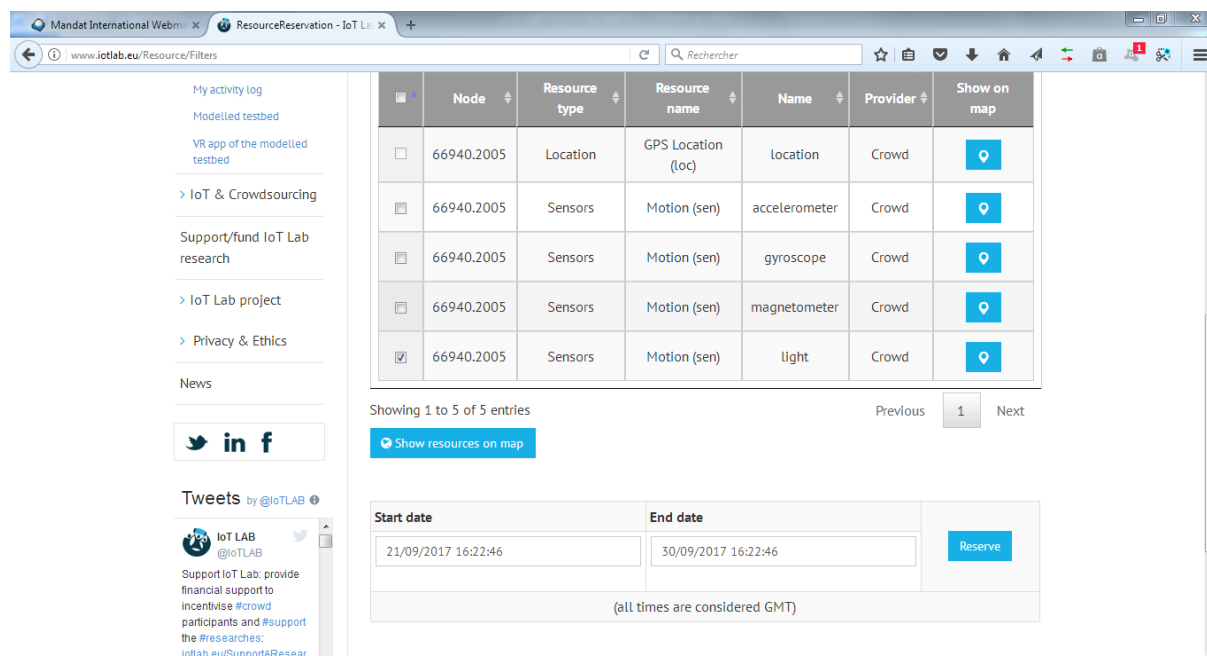
The screenshot shows the IoT Lab ResourceReservation web application. On the left, there is a sidebar with social media links and a tweet from @IoT LAB. The main content area displays a search interface with a search bar and a 'Search' button. Below the search bar, there is a table of resources. The table has columns for Node, Resource type, Resource name, Name, Provider, and Show on map. The table shows 5 entries, all with Node ID 66940.2005 and Provider 'Crowd'. The resources are: GPS Location (loc), Motion (sen) accelerometer, Motion (sen) gyroscope, Motion (sen) magnetometer, and Motion (sen) light. Each entry has a checkbox in the left-hand column and a 'Show on map' button in the right-hand column. Below the table, there is a pagination bar showing 'Showing 1 to 5 of 5 entries' and buttons for 'Previous', '1', and 'Next'. A 'Show resources on map' button is also present.

	Node	Resource type	Resource name	Name	Provider	Show on map
<input type="checkbox"/>	66940.2005	Location	GPS Location (loc)	location	Crowd	
<input type="checkbox"/>	66940.2005	Sensors	Motion (sen)	accelerometer	Crowd	
<input type="checkbox"/>	66940.2005	Sensors	Motion (sen)	gyroscope	Crowd	
<input type="checkbox"/>	66940.2005	Sensors	Motion (sen)	magnetometer	Crowd	
<input type="checkbox"/>	66940.2005	Sensors	Motion (sen)	light	Crowd	

Figure 33: Resources of a mobile phone

As illustrated above, a mobile phone provides the values of its location, accelerometer, gyroscope, magnetometer and light as resources. The user of the smartphone needs to have authorised the data collection from these sensors; if this is not the case, no data are sent to the IoT Lab platform. It is possible to show the resources on a global map by clicking on the corresponding buttons.

To select one or more resources, the researcher must put a tick in the left-hand column of the resource list as shown here:



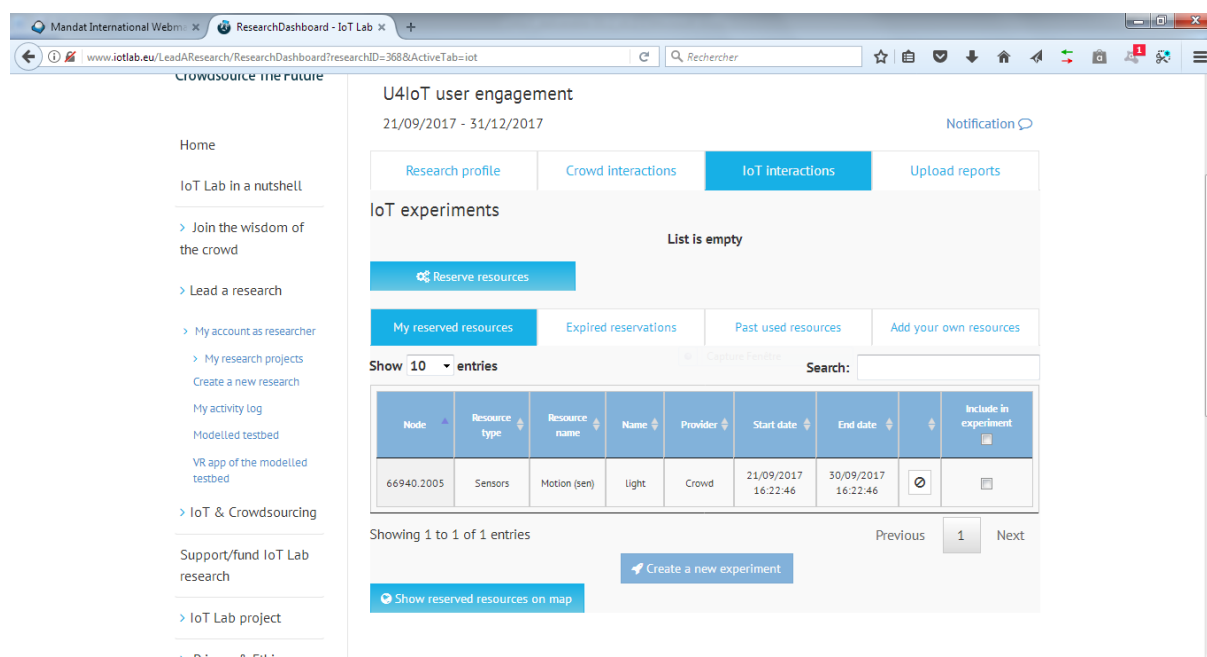
The screenshot shows the 'ResourceReservation - IoT Lab' interface. On the left, there is a sidebar with navigation links: 'My activity log', 'Modelled testbed', 'VR app of the modelled testbed', 'IoT & Crowdsourcing', 'Support/fund IoT Lab research', 'IoT Lab project', 'Privacy & Ethics', and 'News'. Below these are social media links for Twitter and Facebook, and a 'Tweets by @IoT LAB' section. The main content area displays a table of resources for selection:

	Node	Resource type	Resource name	Name	Provider	Show on map
<input type="checkbox"/>	66940.2005	Location	GPS Location (loc)	location	Crowd	
<input type="checkbox"/>	66940.2005	Sensors	Motion (sen)	accelerometer	Crowd	
<input type="checkbox"/>	66940.2005	Sensors	Motion (sen)	gyroscope	Crowd	
<input type="checkbox"/>	66940.2005	Sensors	Motion (sen)	magnetometer	Crowd	
<input checked="" type="checkbox"/>	66940.2005	Sensors	Motion (sen)	light	Crowd	

Below the table, it says 'Showing 1 to 5 of 5 entries' and provides 'Previous' and 'Next' navigation links. A 'Show resources on map' button is also present. At the bottom, there is a reservation form with 'Start date' (21/09/2017 16:22:46) and 'End date' (30/09/2017 16:22:46) fields, and a 'Reserve' button. A note states '(all times are considered GMT)'.

Figure 34: Resource selection

Afterwards, the researcher enters the start and end dates of the reservation. The time is set for the GMT/BST time zone. The reservation is applied once the "Reserve" button on the right-hand side of the screen has been pressed. The newly-reserved resource then appears in the reserved resources tab as displayed below:



The screenshot shows the 'ResearchDashboard - IoT Lab' interface. The left sidebar is identical to Figure 34. The main content area is titled 'U4IoT user engagement' and shows the period '21/09/2017 - 31/12/2017'. There are tabs for 'Research profile', 'Crowd interactions', 'IoT interactions' (selected), and 'Upload reports'. Under 'IoT experiments', it says 'List is empty' and has a 'Reserve resources' button. Below this, there are tabs for 'My reserved resources' (selected), 'Expired reservations', 'Past used resources', and 'Add your own resources'. A 'Show 10 entries' dropdown and a 'Search' field are present. The table below shows the reserved resource:

Node	Resource type	Resource name	Name	Provider	Start date	End date	Include in experiment
66940.2005	Sensors	Motion (sen)	light	Crowd	21/09/2017 16:22:46	30/09/2017 16:22:46	

Below the table, it says 'Showing 1 to 1 of 1 entries' and provides 'Previous' and 'Next' navigation links. A 'Create a new experiment' button and a 'Show reserved resources on map' button are also present.

Figure 35: Reserved resource

Expired and previously-used resources can be seen in the corresponding tabs.



## Creating a new experiment

To incorporate the resources previously reserved into a new experiment, the researcher puts a tick in the right-hand column of the reserved resources list. This column is named “Include in experiment”. After the selection of all the reserved resources required for a new experiment, the researcher clicks on the “Create a new experiment” button to start the experiment composition. The module to compose a new experiment looks like this:

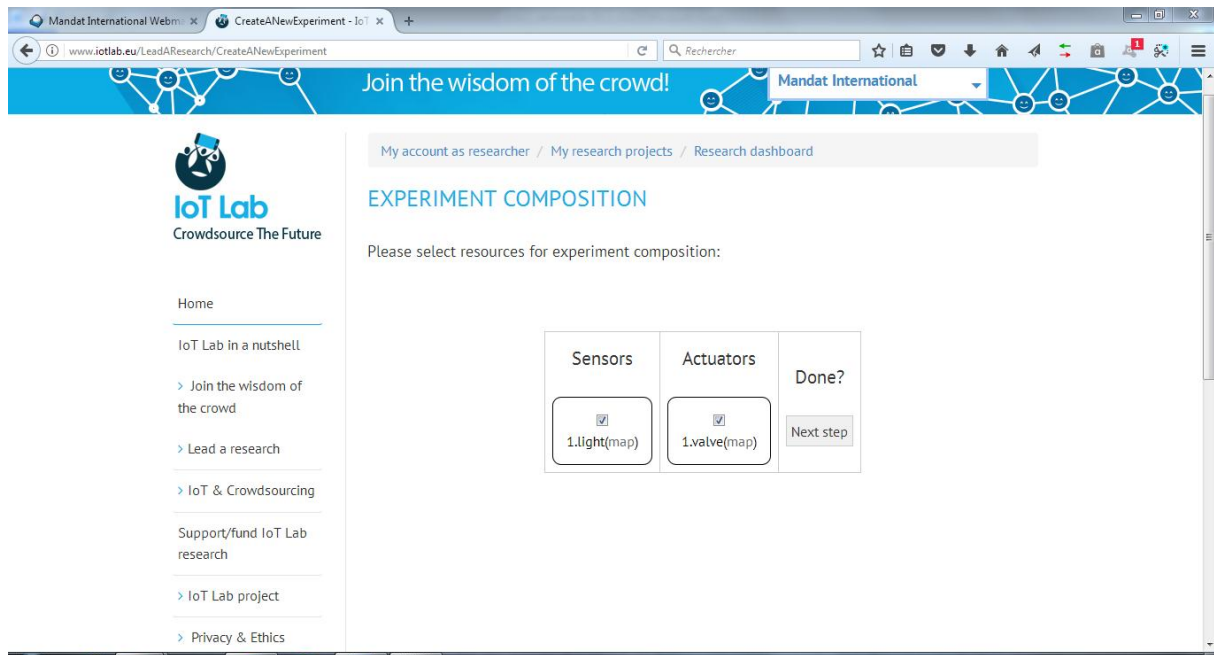


Figure 36: Selection of sensors and actuators

The researcher selects which IoT sensors and which IoT actuators are used in the frame of this new experiment then presses the “Next step” button.

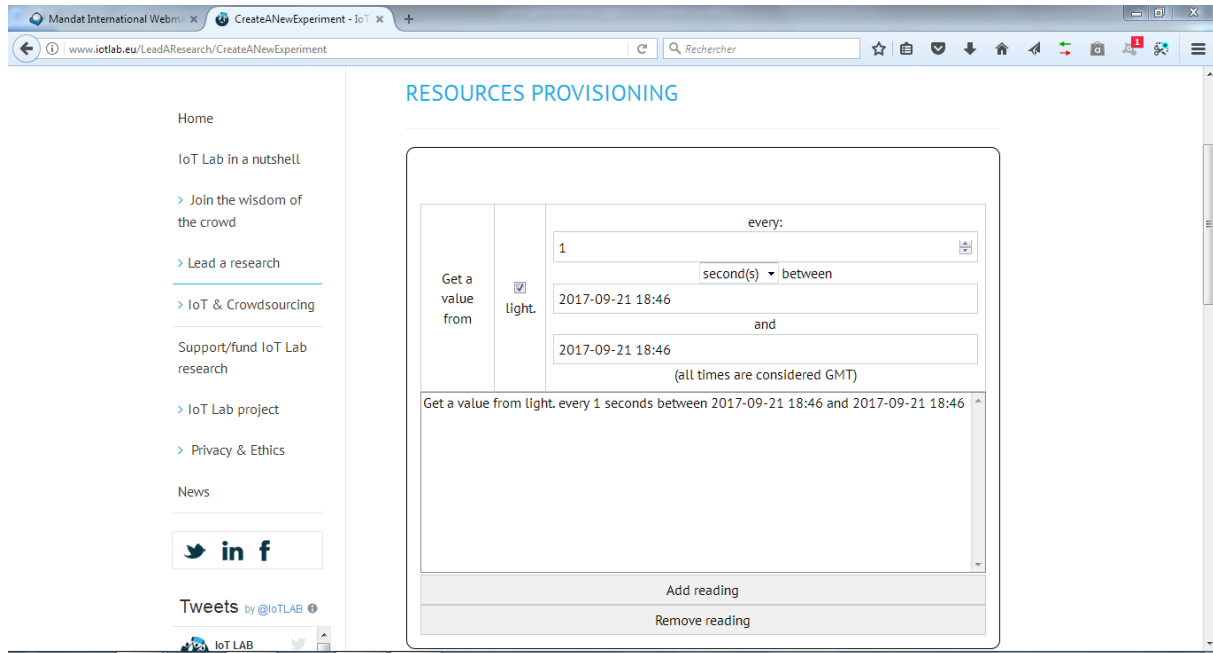


Figure 37: Resources provisioning

The researcher next chooses the value to be retrieved from the sensor, the period between each measurement and the start and end dates of the total period for obtaining values from the sensor. The researcher clicks on the “Add reading” button to validate the resource provisioning.

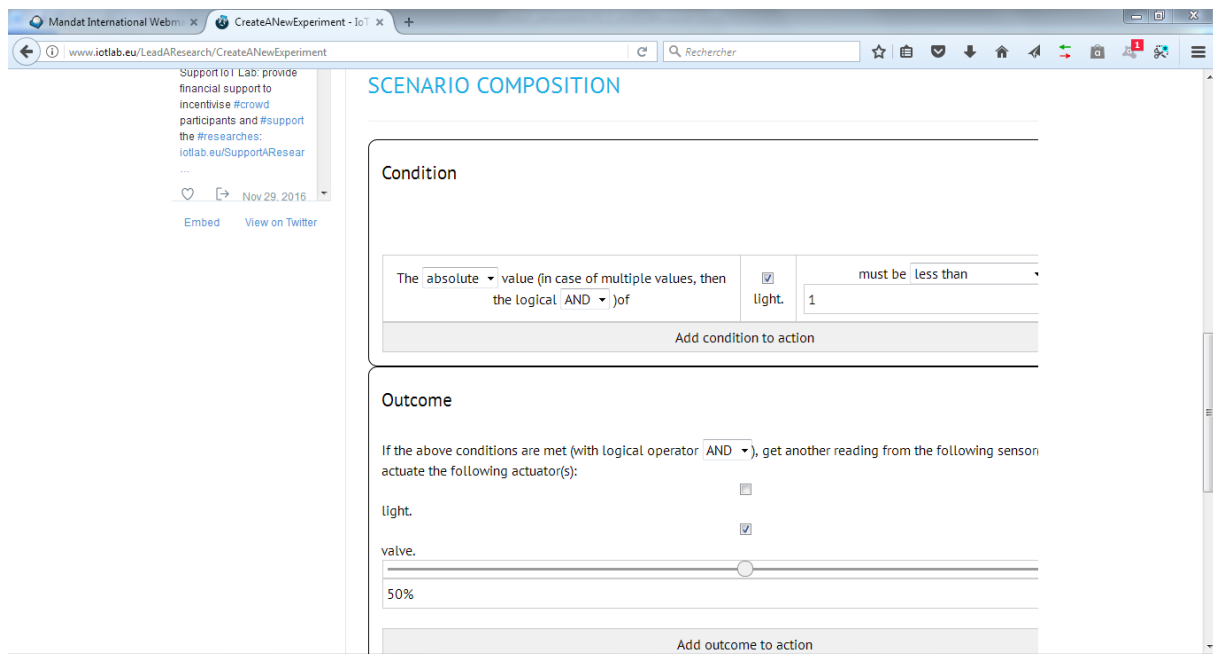


Figure 38: Scenario composition

The next step concerns the actuators and the scenario triggered by the value provided by the sensor. Based on the value sent by the sensor, the researcher can choose the condition triggering the scenario. This is done by completing the

condition part of the scenario composition and by clicking on the “Add condition to action” button.

Then, the researcher creates the scenario which is, in fact, the outcome part of the scenario composition. The researcher selects which actuators will be involved in the outcome and the values to apply to these actuators. To validate this step, the researcher presses the “Add outcome to action button”.

To finalise the scenario, the researcher checks the two fields making the sentence “If... then...” as illustrated here:

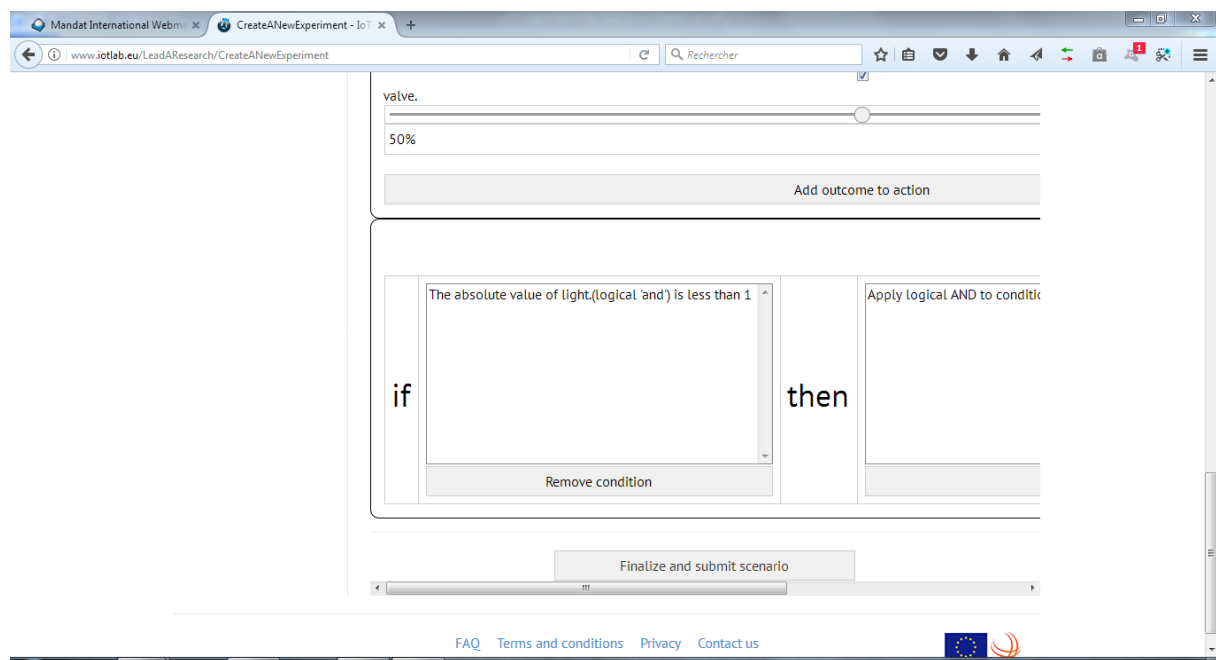


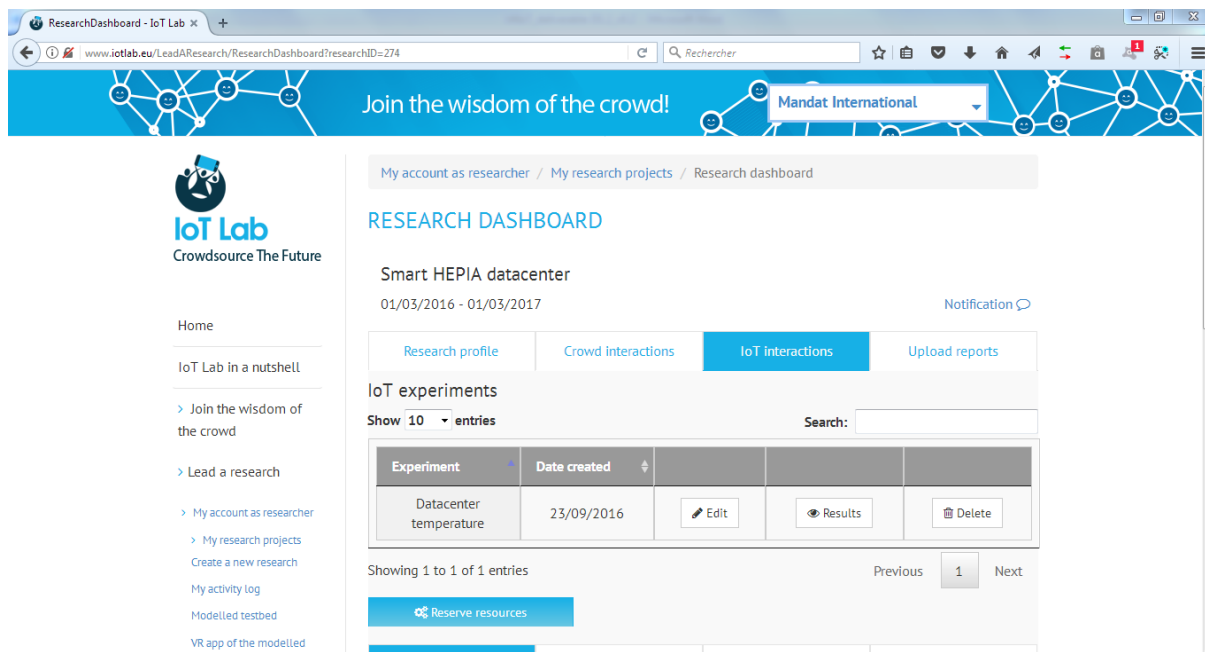
Figure 39: Finalise the scenario

The condition is placed just after the “if” word and the tiny sentence just after the “then” statement corresponds to the outcome of the defined scenario. At the end, the researcher submits the scenario using the button named “Finalise and submit scenario”. This scenario will be executed following the date and time previously defined by the researcher. Selecting a condition is optional but may be helpful in controlling the size of the dataset that is generated.

Once the resources/users’ smartphone sensors have been chosen and the times when data will be collected have been submitted, the users’ smartphones will automatically collect the requested data at the times selected. If a user does not have a given sensor or has not given permission to use that sensor, those sensors simply will not appear in the list of available resources in the first place.

## Results of an experiment

The results of an experiment are available on the corresponding research dashboard after the end of the experiment as displayed below:

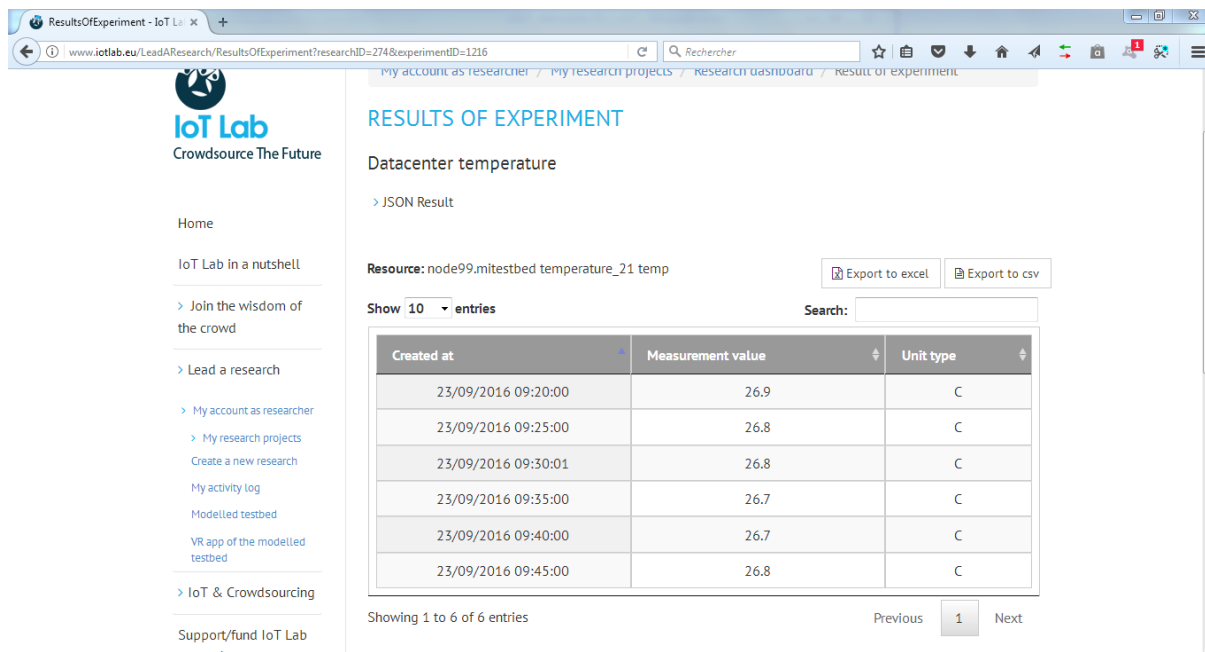


The screenshot shows the 'Research Dashboard' for a researcher. The main heading is 'RESEARCH DASHBOARD'. Below it, the experiment is identified as 'Smart HEPIA datacenter' with a date range of '01/03/2016 - 01/03/2017'. There are four tabs: 'Research profile', 'Crowd interactions', 'IoT interactions' (which is selected), and 'Upload reports'. Under the 'IoT interactions' tab, there is a section for 'IoT experiments'. It shows a list of experiments with columns for 'Experiment', 'Date created', and actions. The first entry is 'Datacenter temperature' created on '23/09/2016'. Below the list, there are buttons for 'Edit', 'Results', and 'Delete'. At the bottom of the list, there is a 'Reserve resources' button.

Experiment	Date created			
Datacenter temperature	23/09/2016	Edit	Results	Delete

Figure 40: Results of an experiment

The name of the experiment is shown followed by the date of creation of the experiment. Three buttons allow the researcher to change the title or description of the experiment ("Edit" button), to delete it ("Delete" button) and to see the results ("Results" button). Pressing this last button leads to the following web page:



The screenshot shows the 'RESULTS OF EXPERIMENT' page. The experiment is 'Datacenter temperature'. Below it, there is a 'JSON Result' link. The 'Resource' is 'node99.mitestbed temperature\_21 temp'. There are buttons for 'Export to excel' and 'Export to csv'. Below this, there is a table showing the results of the experiment. The table has columns for 'Created at', 'Measurement value', and 'Unit type'. There are 6 entries in the table.

Created at	Measurement value	Unit type
23/09/2016 09:20:00	26.9	C
23/09/2016 09:25:00	26.8	C
23/09/2016 09:30:01	26.8	C
23/09/2016 09:35:00	26.7	C
23/09/2016 09:40:00	26.7	C
23/09/2016 09:45:00	26.8	C

Figure 41: Results

Each measurement of the experiment is displayed on its own line and comprises three columns: the date and the time of the measurement, the value and the unit. This part will evolve in the future. The researcher can download all these results in an

Excel file or in a CSV file by pressing the respective buttons on the top-right of the measurements list.

## Upload reports

From the research board, the researcher can upload a report via the “Upload reports” tab as illustrated here:

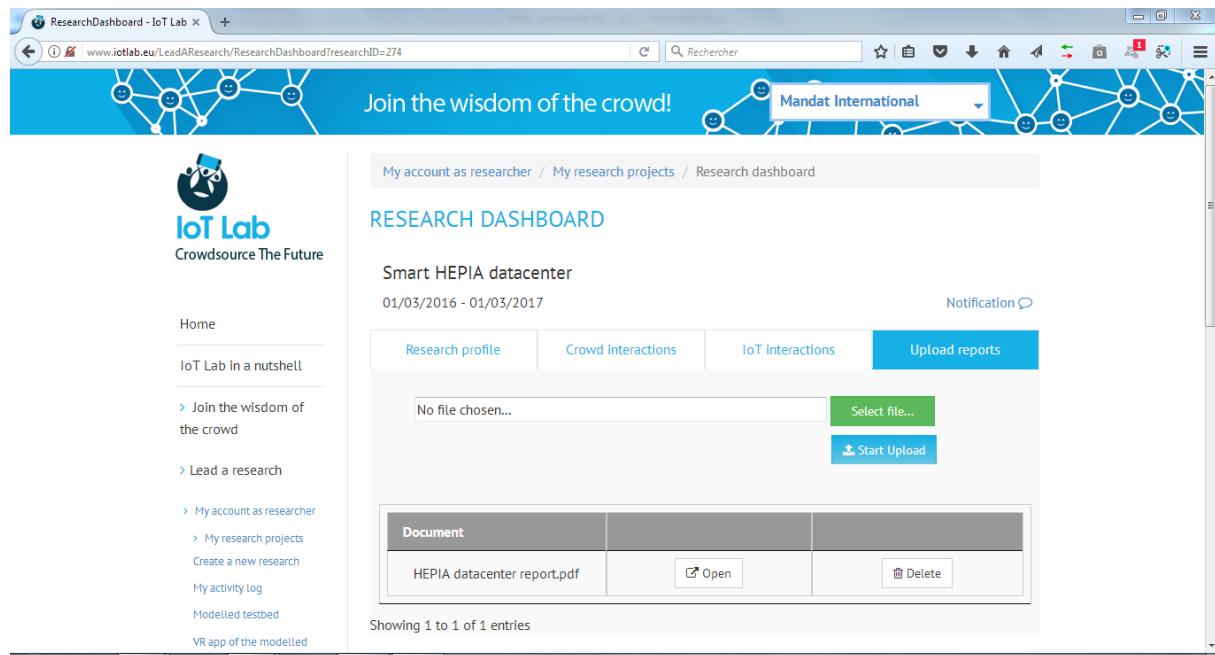


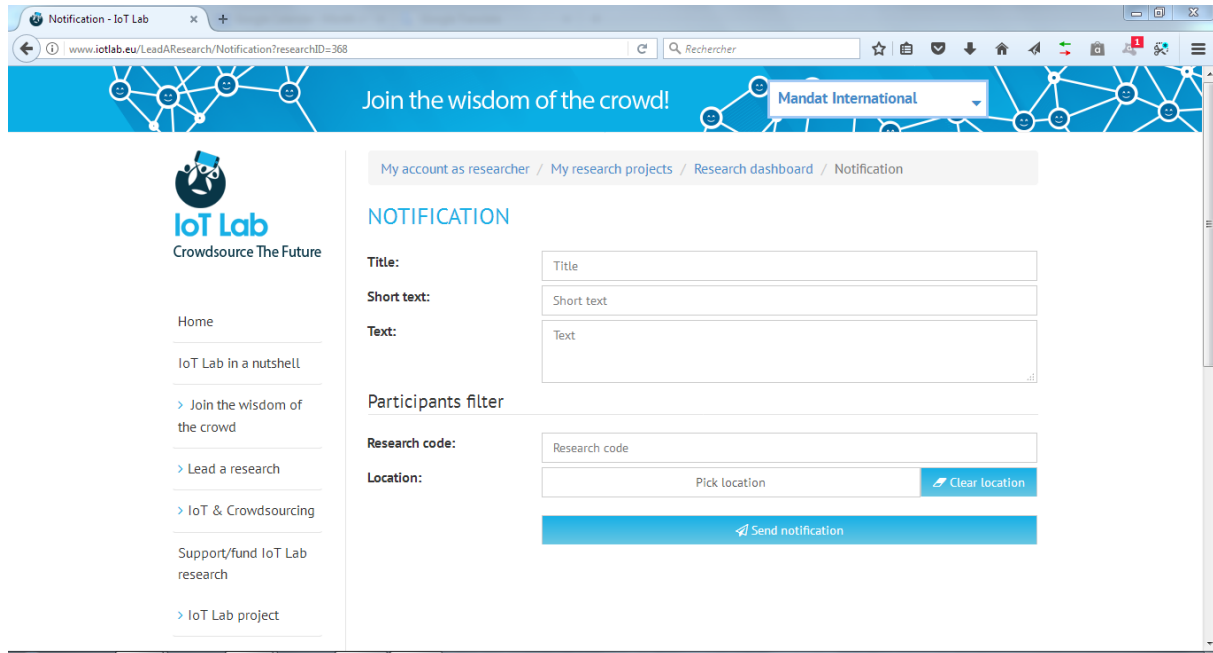
Figure 42: Upload reports

The researcher selects the file to be uploaded to the IoT Lab website from his hard drive using the green button. The format of the file is PDF. By pressing the “Start Upload” button, the file is uploaded onto the IoT Lab platform.

The available PDF documents are displayed in the list named “Document”: the name of each file is shown and the file can be opened and erased using the corresponding buttons.

## Notifications

On the top-right of each research dashboard, a button named “Notification” permits the researcher to send short messages to the IoT Lab application installed on the users' smartphones. The title of a new notification and its content can be written in the fields shown here:



The screenshot shows a web browser window with the URL `www.iotlab.eu/LeadAResearch/Notification?researchID=368`. The page has a blue header with the text "Join the wisdom of the crowd!" and a dropdown menu for "Mandat International". A breadcrumb trail at the top reads: "My account as researcher / My research projects / Research dashboard / Notification".

On the left is a sidebar with the IoT Lab logo and the tagline "Crowdsource The Future". It contains a list of links: "Home", "IoT Lab in a nutshell", "Join the wisdom of the crowd", "Lead a research", "IoT & Crowdsourcing", "Support/fund IoT Lab research", and "IoT Lab project".

The main content area is titled "NOTIFICATION". It contains the following form fields:

- Title:** A text input field.
- Short text:** A text input field.
- Text:** A larger text input area.
- Participants filter:** A section containing:
  - Research code:** A text input field.
  - Location:** A text input field with a "Pick location" button and a "Clear location" button.

At the bottom of the form is a large blue button labeled "Send notification" with a paper plane icon.

Figure 43: Notification

The selection of the users receiving the notification is made in two ways: the research/project code or the geo-fencing function. These two methods to send a notification are exactly the same as in the selection of resources during the process of resource reservation described earlier in this document. The "Send notification" button sends the new notification to the relevant users. Once again, the research code plays an important role here.

The users can also send messages and these messages are displayed in the "Messages" section of the website. To reach this section, the researcher clicks on the "Messages" button at the top-right of their main page. The ability to send messages from the application is found by choosing the relevant research project page in the application and selecting the button labelled "Contact".

## My activity log

From the main page of a researcher's account, the statistics associated with a researcher are displayed after pressing the "My activity log" button. The information available is the number of created research projects, the number of ratings for the experiments, the total score of ratings and the researcher's budget.

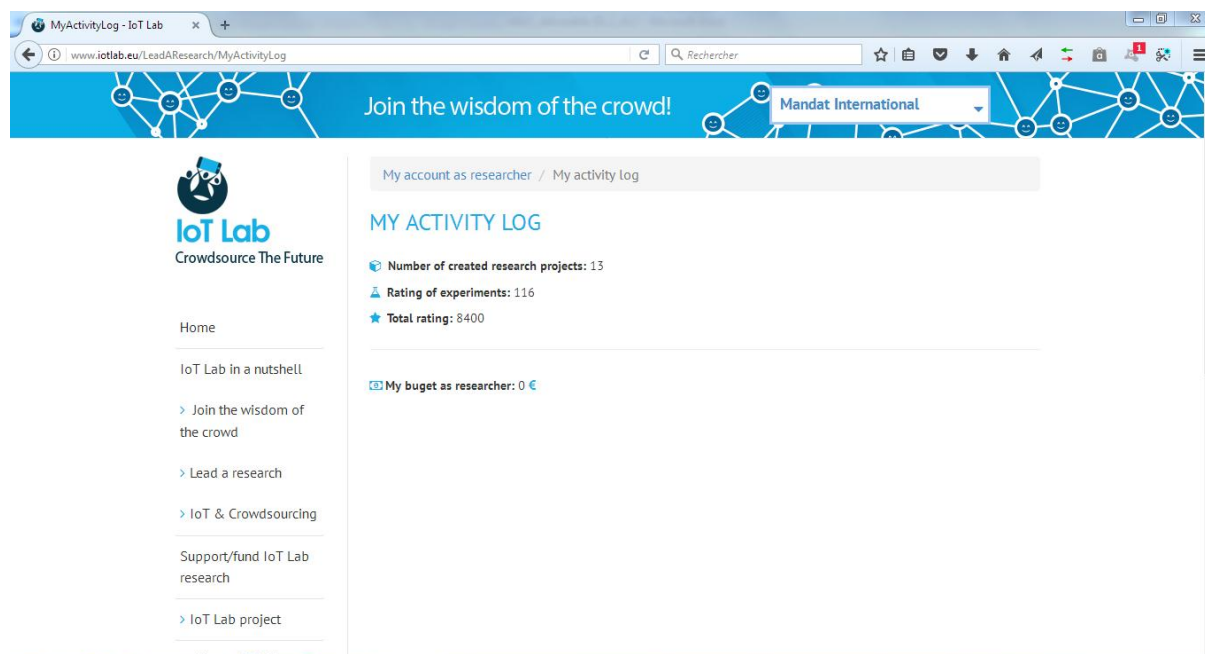


Figure 44: My activity log

## Get inspired

The “Get inspired” button sends the researcher to the list of the top ranked research ideas proposed by the IoT Lab crowd as shown here:

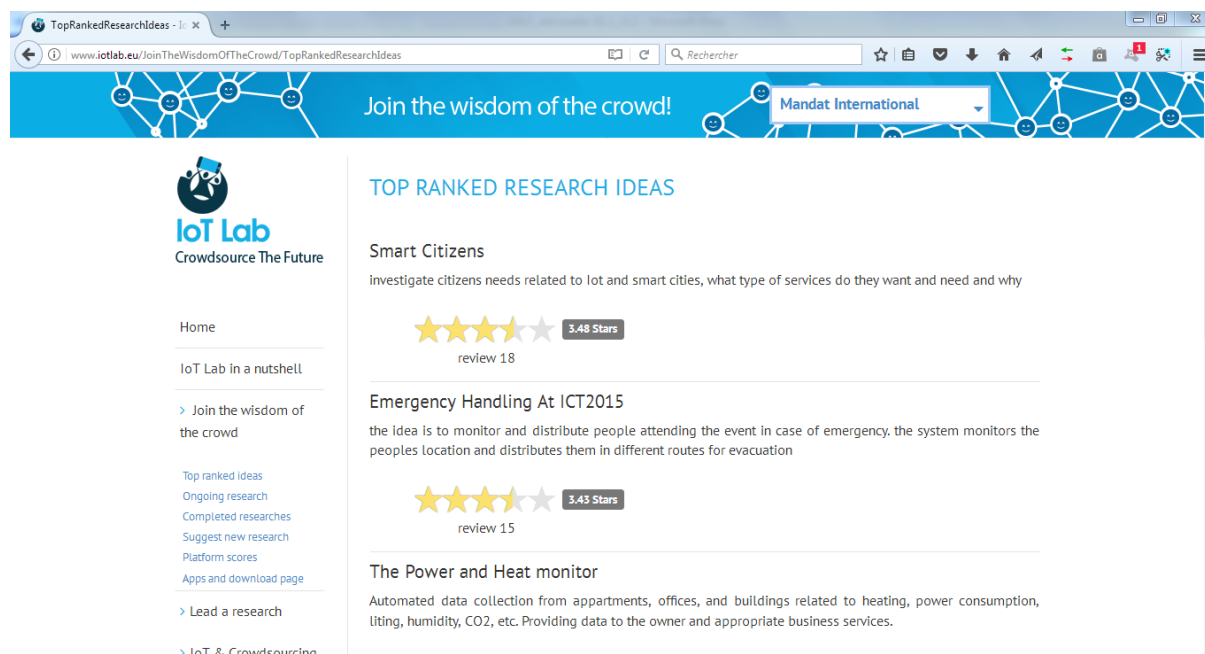


Figure 45: Get inspired

This relates directly to the section of the smartphone application labelled “Ideas”.

## Ongoing research

The “Ongoing research” button available on the main page opens a web page with all the currently-running research projects. For each project, the name of the researcher, his company or organisation, the main beneficiaries, the description and the objectives of the project are displayed, followed by the start and end dates of the project as well as its category.

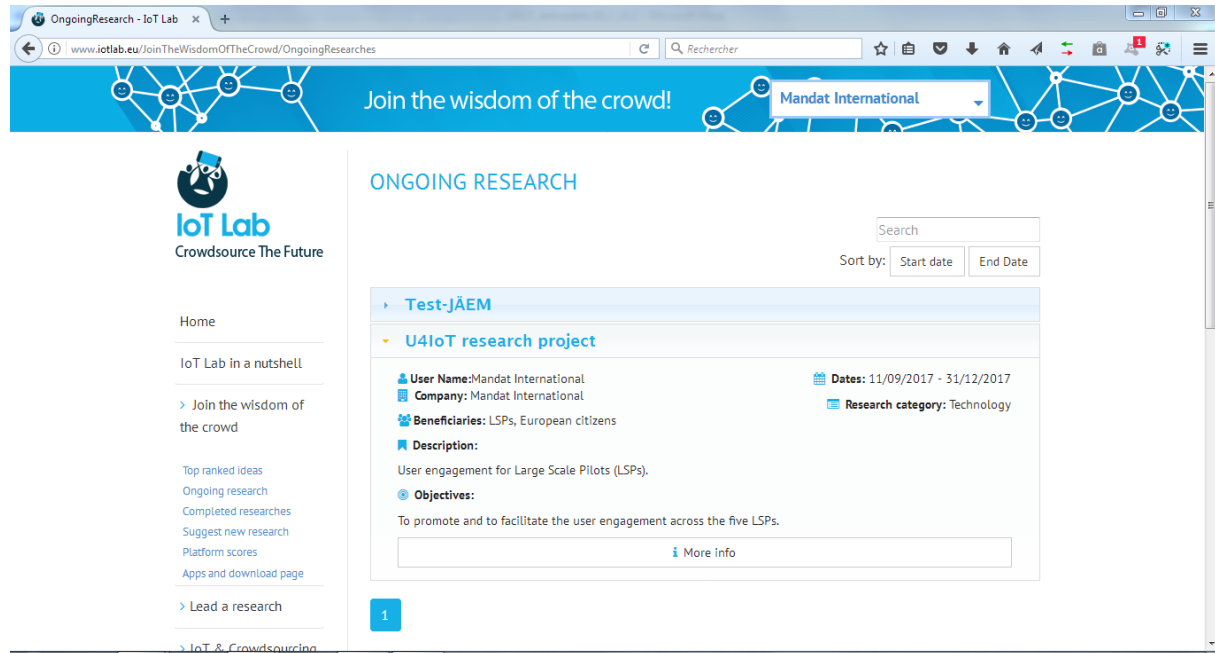
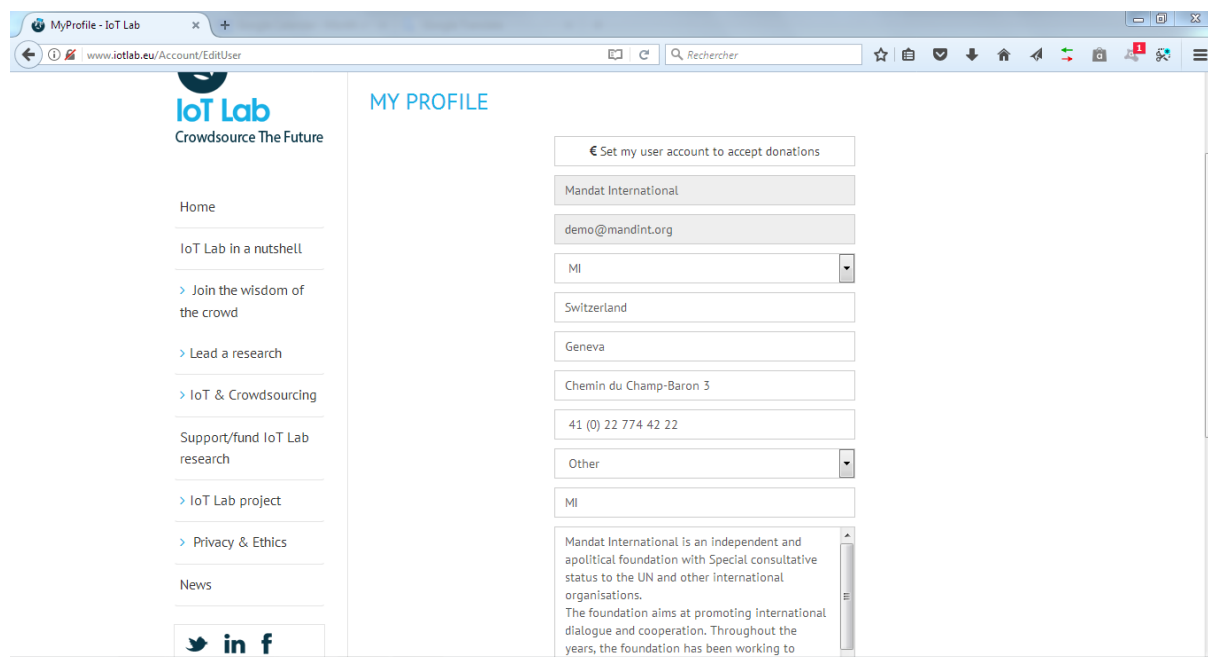


Figure 46: Ongoing research

## My profile

Finally, the “My profile” button on the main page permits the researcher to access all the information of his profile and to edit each field as shown below:





The screenshot shows a web browser window with the URL [www.iotlab.eu/Account/EditUser](http://www.iotlab.eu/Account/EditUser). The page is titled "MY PROFILE" and features a sidebar on the left with the IoT Lab logo and navigation links: Home, IoT Lab in a nutshell, Join the wisdom of the crowd, Lead a research, IoT & Crowdsourcing, Support/fund IoT Lab research, IoT Lab project, Privacy & Ethics, and News. The main content area contains a form for editing the user profile. The form includes a checkbox for "Set my user account to accept donations", a text field for "Mandat International", an email field for "demo@mandint.org", a dropdown menu for "MI", a text field for "Switzerland", a text field for "Geneva", a text field for "Chemin du Champ-Baron 3", a text field for "41 (0) 22 774 42 22", a dropdown menu for "Other", and a text field for "MI". Below the form is a text area containing the following text: "Mandat International is an independent and apolitical foundation with Special consultative status to the UN and other international organisations. The foundation aims at promoting international dialogue and cooperation. Throughout the years, the foundation has been working to".

Figure 47: My profile

The researcher must click on the "Save" button at the end of this web page to register the changes.

## SECTION 3: THE SURVEY TOOL

### INTRODUCTION

The survey tool introduced by the IoT Lab project permits researchers to create surveys personalised for their domains of research and to distribute the surveys via the IoT Lab mobile application. The users can respond to every question written in the surveys from the mobile application and, afterwards, the researchers can analyse the results of each survey and learn the opinions of the crowd. The survey tool provided in the frame of the IoT Lab platform is based on a LimeSurvey<sup>2</sup> server and is accessed using the IoT Lab website described in the previous section

### HOW TO USE THE SURVEY TOOL

First of all, the researcher needs a valid account on the IoT Lab platform. The process to get one is described at the beginning of Section 2. After logging in, the researcher comes to the main page of their account. The “My research projects” button leads to the list of all of the researcher's research projects. They select the research project in which the new survey should be conducted by clicking on the name of the project. The research dashboard appears containing the profile of the project. To reach the survey tool, the researcher clicks on the “Crowd interactions” tab where they will see this:

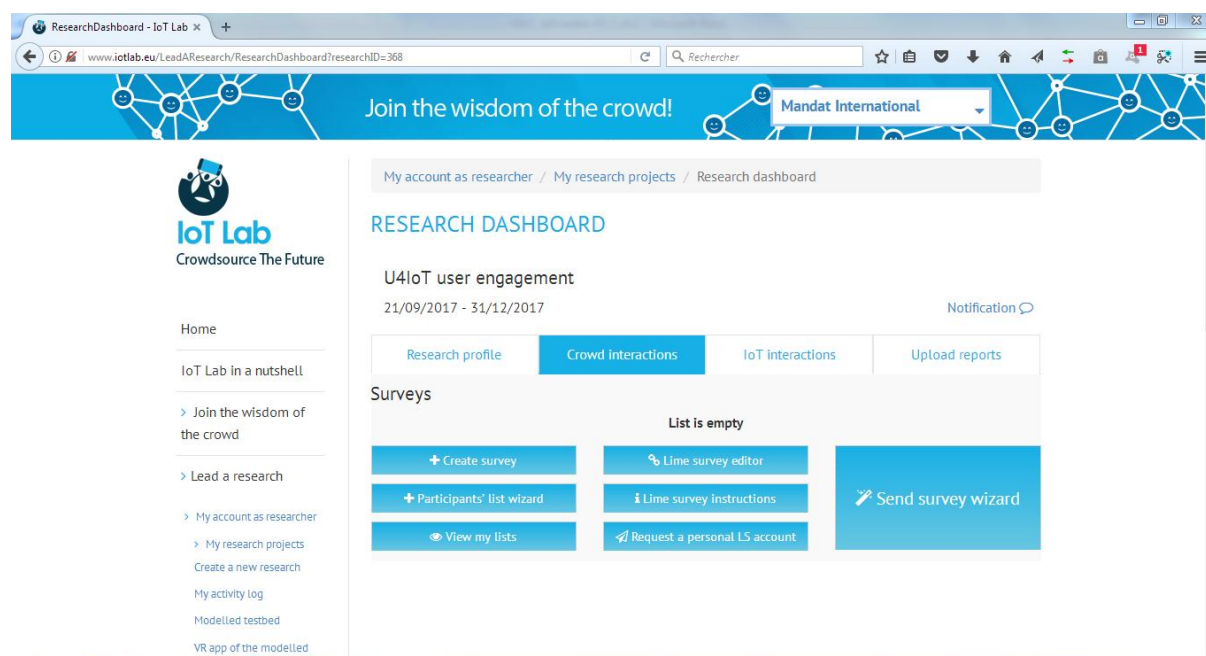
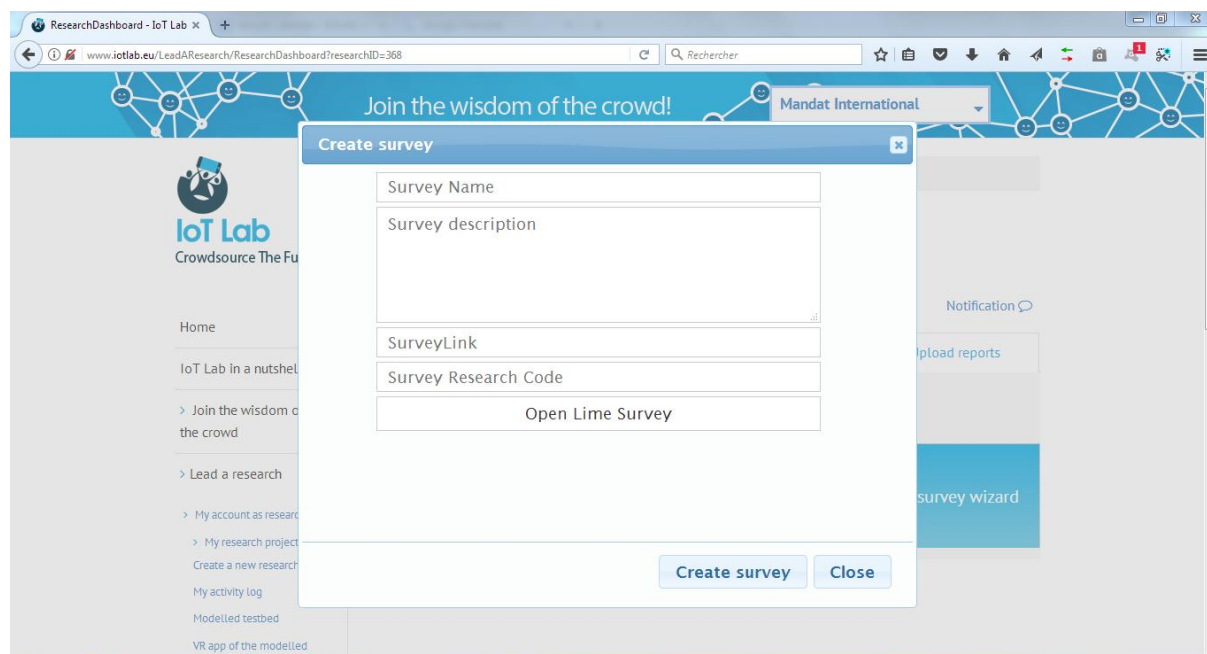


Figure 48: Survey tool

### Create survey

<sup>2</sup> <https://www.limesurvey.org/>

To create a new survey, the corresponding button should be pressed by the researcher. A pop-up window appears:



The screenshot shows a web browser window with the URL [www.iotlab.eu/LeadAResearch/ResearchDashboard?researchID=368](http://www.iotlab.eu/LeadAResearch/ResearchDashboard?researchID=368). The page has a blue header with the text "Join the wisdom of the crowd!" and a "Mandat International" dropdown menu. The main content area is a light gray sidebar with the IoT Lab logo and a list of navigation links: Home, IoT Lab in a nutshell, Join the wisdom of the crowd, Lead a research, My account as researcher, My research project, Create a new research, My activity log, Modelled testbed, and VR app of the modelled. A "Create survey" button is visible in the sidebar. A pop-up window titled "Create survey" is open in the center, containing the following fields: Survey Name, Survey description, SurveyLink, and Survey Research Code. Below these fields is a button labeled "Open Lime Survey". At the bottom of the pop-up window are two buttons: "Create survey" and "Close".

Figure 49: Create survey

The researcher enters the name of the survey, its description, the link for the survey and the research code (if required). The survey link can be found by opening LimeSurvey ("Open Lime Survey" button), after which the researcher creates the survey as instructed by the official manual available here: <https://manual.limesurvey.org/Surveys - introduction>. The researcher then goes to the main page of the newly created survey on the LimeSurvey server and the survey link is provided by the LimeSurvey server just after the title of the survey in the field labelled "Survey URL". The value of this field must be copy-pasted to the "Survey Link" field in the IoT Lab form to create the survey.

The survey research code is similar to the research (or project) code mentioned earlier in this document although, crucially, it is not the same. A special survey research code should only be used if the general project research code is not sufficient for the LSP's requirements. After the successful creation of the survey, the web page on the IoT Lab platform is updated with the new survey as illustrated below:

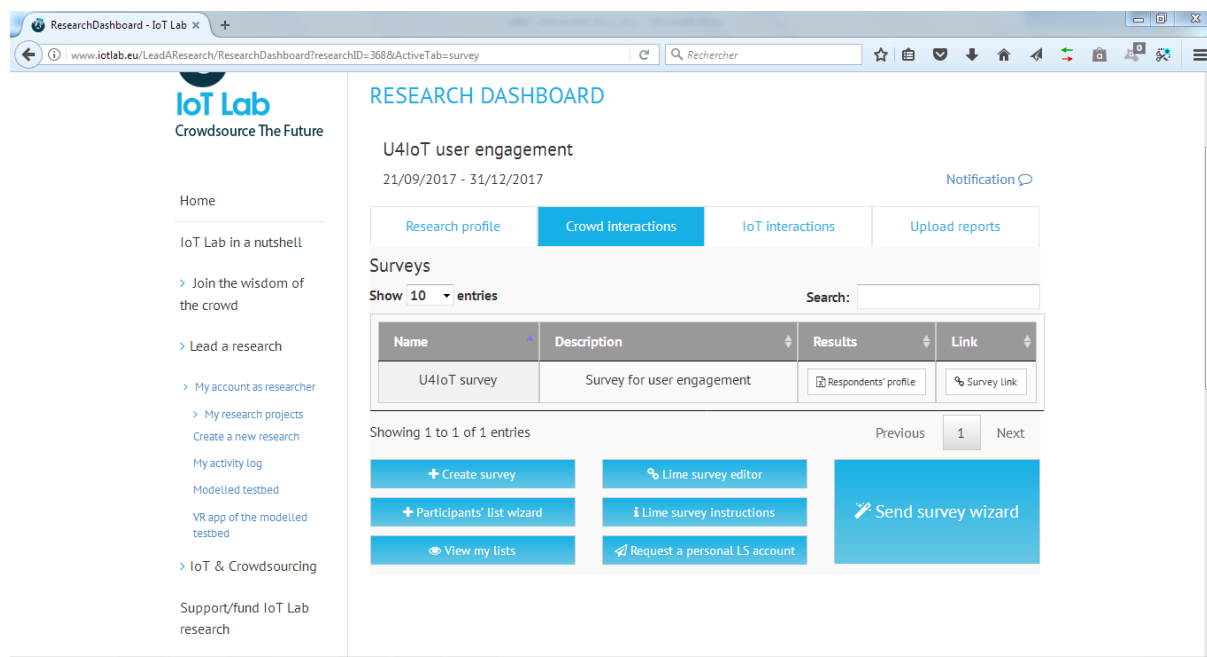


Figure 50: New survey created

The name of the new survey and its description, followed by two buttons, are now displayed on this web page. The first button permits retrieval of the results of the survey when it is completed: the results are presented as an Excel file generated from the LimeSurvey server. The second button opens the survey using the survey link provided by the LimeSurvey server.

## LimeSurvey editor

The "Lime survey editor" button opens the LimeSurvey server and displays the list of all the surveys. Afterwards, the researcher can modify his chosen survey.

## Participants list wizard

The button named "Participants list wizard" allows the researcher to select users according to different criteria available through their profiles. This list of participants will be used to send the survey to the right group of users, depending on the criteria selected by the researcher.

The first step is to give a name to this new list of participants. The second step is to filter the criteria needed to target the right users. The available criteria are age, gender, hometown, country, education level and location. The research code can also be taken into account alongside the other criteria. The researcher confirms the list of participants using a final selection of the participants.

To use pre-determined set of users, it is enough to use the research code described in Section 2. Asking intended recipients to add a pre-agreed research code to their settings and then filtering based on this code is the most efficient way to do this.

## View my lists

The researcher can see all the lists of participants by pressing the “View my lists” button on the main page of the survey tool. The corresponding pop-up window is shown below:

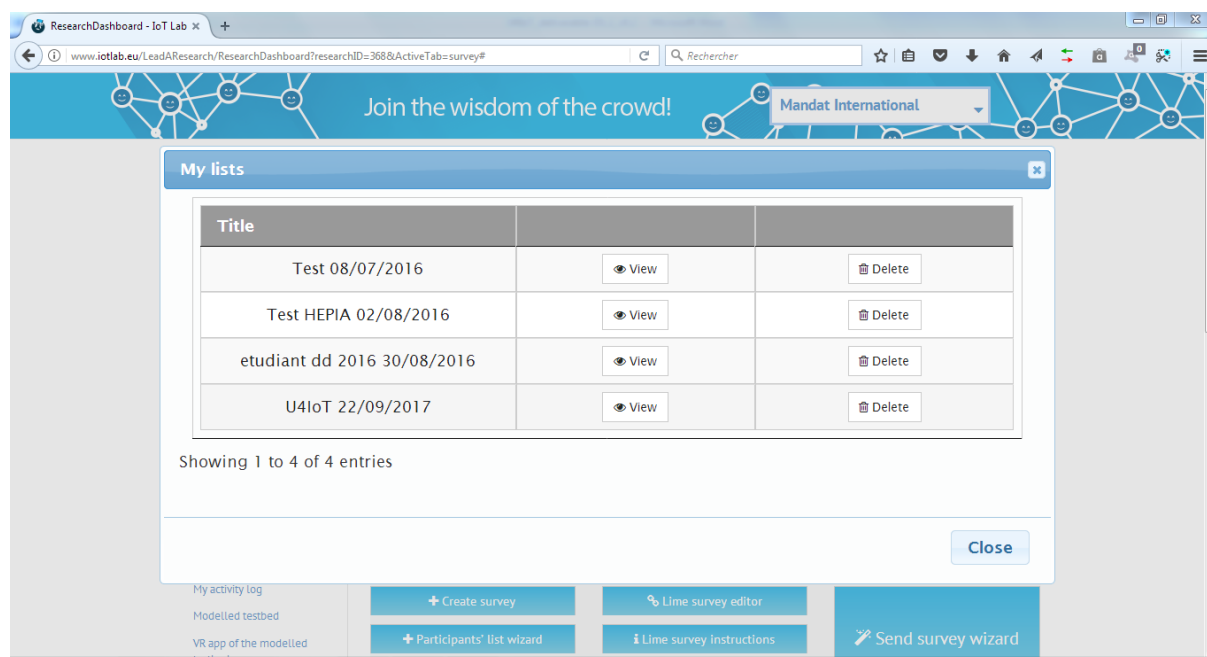


Figure 51: Lists of participants

For each list of participants, two buttons are displayed just after the name of the list. The first button (“View”) opens a new pop-up window containing the list of all participants. This means that all the criteria used by the researcher during the creation of each list are displayed on the header of the pop-up window followed by a line for each participant and their values corresponding to the criteria as shown here:

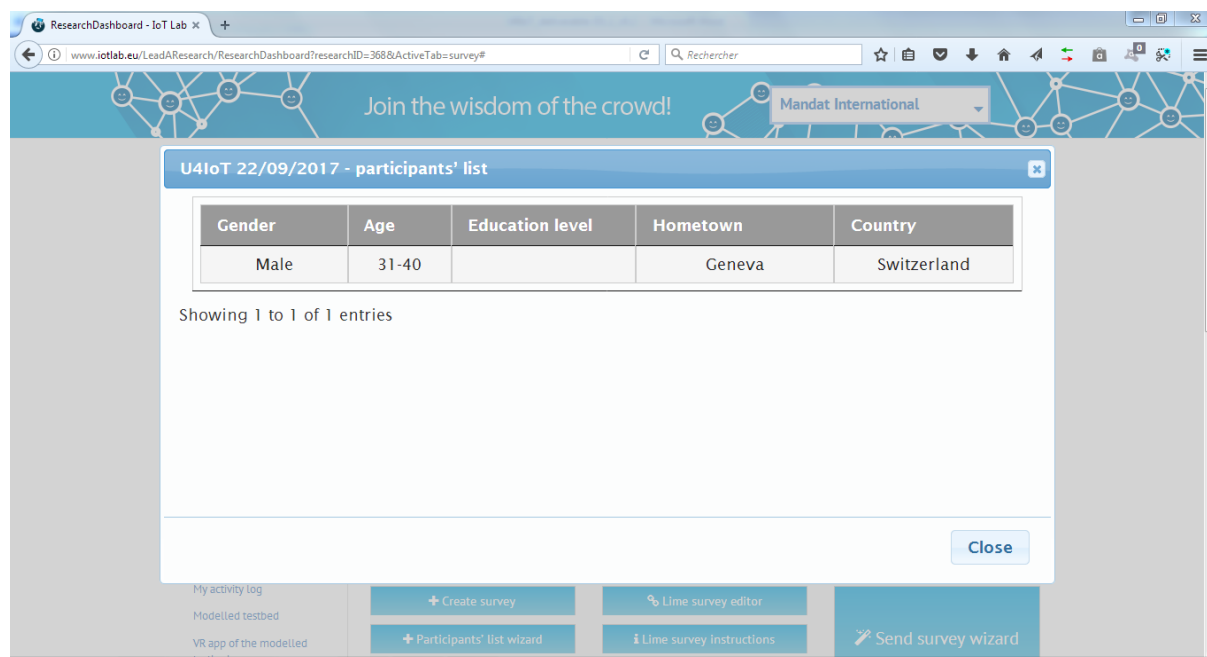


Figure 52: A list of participants

After closing the previous pop-up window, the researcher can once again see all the participant lists. The second button, named "Delete", permits the erasure of any list of participants.

### LimeSurvey instructions

Some information is displayed on the IoT Lab website about the LimeSurvey server and can be useful when creating a survey. The button "Lime survey instructions" takes the researcher to this web page.

### Request a personal LimeSurvey account

There is a possibility to obtain a personal account for the IoT Lab LimeSurvey server using the "Request a personal LS account" button. An email is sent to the IoT Lab platform administrator once the researcher has pressed this button. The system administrator of IoT Lab can accept or refuse this request.

### Send survey wizard

The last step to send a survey to a group of users is described in this section. The button "Send survey wizard" opens a wizard composed of different steps to be done by the researcher.

First of all, the researcher selects the list of participants to be used. Then, the researcher chooses the survey to send to the listed participants. Finally, the name of the participants list and the name of the survey are written on the screen like this:

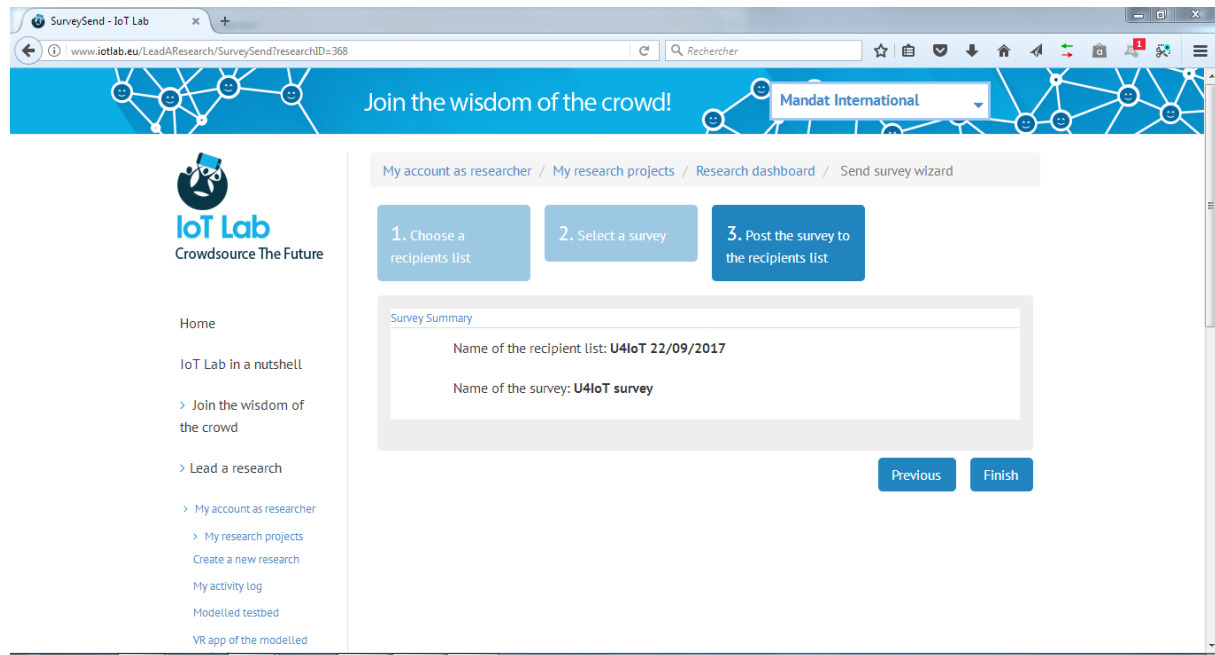


Figure 53: Sending a survey

So the list of participants and the survey are now linked and the survey can be sent by the researcher using the “Finish” button. Normally, each user present in the list will receive a notification on their smartphone indicating that there's a new survey to be answered. Users can then complete the survey on their smartphones and the responses will be available to the LSPs on the IoT Lab website.

## CONCLUSIONS

The IoT Lab mobile application has been improved and updated to respond to the requirements of the U4IoT project. This means that LSPs will have direct and quick feedback from the people who are most important for them: the end-users. They'll also be able to easily retrieve qualitative and quantitative feedback for their projects. At the same time, the IoT Lab website has received some updates. These modifications should permit the U4IoT project to have useful crowdsourcing tools that will encourage partners and stakeholders to engage citizens in the five LSPs. The IoT Lab platform and the U4IoT project have the same goal: to encourage the general public to change the world by using new technologies related to the Internet of Things.