score

D4.3-Citizen science DIY framework

DATE OF DELIVERY – 30/06/2023

AUTHORS – Saul Crowley, Chiara Cocco, Francesco Pilla
University College Dublin

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003534

DOCUMENT TRACKS DETAILS

Project acronym	SCORE
Project title	Smart Control of the Climate Resilience in European Coastal Cities
Starting date	01.07.2021
Duration	48 months
Call identifier	H2020-LC-CLA-2020-2
Grant Agreement No	101003534

Deliverable Information	
Deliverable number	D4.3
Work package number	WP4
Deliverable title	Citizen science DIY framework
Lead beneficiary	UCD
Author(s)	Saul Crowley (UCD), Chiara Cocco (UCD), Francesco Pilla (UCD)
Due date	30/06/2023
Actual submission date	30/06/2023
Type of deliverable	Report
Dissemination level	Public

VERSION MANAGEMENT

Revision table			
Version	Name	Date	Description
V 0.1	Saul Crowley (UCD)	12/06/2023	First draft
V 0.2	Marta I. De Los Rios White (ENOLL) Attilio Vaccaro (MBI) Laura De Nale (Euronovia)	20/06/2023	Updated draft internally reviewed
V 0.3	Saul Crowley (UCD)	20/06/2023	Updated draft after contribution from partners
V0.4	Iulia Anton (ATU Sligo) Salem Gharbia (ATU Sligo)	27/06/2023	Final version

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Meaning / Full text
API	Application Programming Interface
CCLL	Coastal City Living Lab
DIY	Do It Yourself
EBA	Ecosystem-Based Approach
KAP	Kite Aerial Photography
WP	Work Package
SD	Secure Digital
STA	Sensor Things API
USB	Universal Serial Bus
Wi-Fi	Wireless Fidelity (network)

BACKGROUND: ABOUT THE SCORE PROJECT

SCORE is a four-year EU-funded project aiming to increase climate resilience in European coastal cities.

The intensification of extreme weather events, coastal erosion and sea-level rise are major challenges to be urgently addressed by European coastal cities. The science behind these disruptive phenomena is complex, and advancing climate resilience requires progress in data acquisition, forecasting, and understanding of the potential risks and impacts for real-scenario interventions. The Ecosystem-Based Approach (EBA) supported by smart technologies has potential to increase climate resilience of European coastal cities; however, it is not yet adequately understood and coordinated at European level.

SCORE outlines a co-creation strategy, developed via a network of 10 coastal city 'living labs' (CCLLs), to rapidly, equitably and sustainably enhance coastal city climate resilience through EBAs and sophisticated digital technologies.

The 10 coastal city living labs involved in the project are: Sligo and Dublin, Ireland; Barcelona/Vilanova i la Geltrú, Benidorm and Basque Country, Spain; Oeiras, Portugal; Massa, Italy; Piran, Slovenia; Gdansk, Poland; Samsun, Turkey.

SCORE will establish an integrated coastal zone management framework for strengthening EBA and smart coastal city policies, creating European leadership in coastal city climate change adaptation in line with The Paris Agreement. It will provide innovative platforms to empower stakeholders' deployment of EBAs to increase climate resilience, business opportunities and financial sustainability of coastal cities.

The SCORE interdisciplinary team consists of 28 world-leading organisations from academia, local authorities, RPOs, and SMEs encompassing a wide range of skills including environmental science and policy, climate modelling, citizen and social science, data management, coastal management and engineering, security and technological aspects of smart sensing research.

EXECUTIVE SUMMARY

This document is a deliverable of the SCORE project, funded under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003534.

This report provides an overview of the work completed under Task 4.3 – educating CCLL local communities to make use of the self-sustainable citizen science sensors, via a short visual report detailing the framework used for the DIY citizen science workshops. Citizen science is a collaborative approach that involves ordinary individuals contributing their time, skills, and knowledge to scientific research. The report outlines the onboarding procedures for low-cost sensors and the development of an online platform to empower citizens in assembling and deploying sensors. It highlights the selection and assembly processes for four sensors and describes the steps involved in registering data from the sensors. The report also discusses the varying levels of complexity in sensor components and assembly, along with troubleshooting techniques. Additionally, it emphasizes the importance of workshops in engaging stakeholders and addressing local environmental challenges. Overall, the framework presented in this report is intended to promote public engagement, scientific literacy, and environmental awareness through citizen science activities.

LINKS WITH OTHER PROJECT ACTIVITIES

The outputs from this deliverable are also intended to be utilised as part of the activities under Task 9.6 – EBA Training Schools. Under WP9 instructional materials are being developed with the aim to facilitate the training of local communities in citizen science techniques using the approach developed as part of Task 4.3 and the sensors selected under Task 4.2.

TABLE OF CONTENT

INDEX OF FIGURES

1. VISUAL REPORT DETAILING THE FRAMEWORK USED FOR DIY CITIZEN SCIENCE WORKSHOPS

Citizen science involves ordinary individuals collaborating with scientists to contribute their time, skills, and knowledge to scientific research. It enables people with no scientific background to actively participate in projects by collecting data, making observations, and analysing information. This inclusive approach is a core element of the SCORE Project, with researchers particularly working to develop methods to facilitate greater levels of participation from members of the public through technology and online platforms. Citizen science not only enhances research capacity but also promotes public engagement, scientific literacy, and environmental awareness. By democratizing knowledge creation, citizen science empowers individuals to address complex scientific challenges and fosters a sense of connection and responsibility towards the scientific community.

As part of Task 4.3 'Make' we are currently developing onboarding procedures for the low-cost sensors previously selected under Work Package 4. The aim is to empower citizens in assembling and deploying sensors either independently or through workshops organised under the SCORE Project and create a process for capturing the data these sensors will output. Initial versions of the onboarding process for a number of sensors have been outlined below and are currently being refined further.

1.1. DIY Sensors

As a preliminary step, a small-scale deployment of sensors is currently underway in the leading CCLLs of Dublin, Sligo Oerias, Vilanova and Massa to identify and mitigate any technical or practical challenges that might impede the successful implementation of citizen science activities in other CCLLs. Four sensors (see Figure 6) have been selected by the WP4 team for the pilot phase. These sensors were selected for the range of environmental variables they monitor that are relevant to the CCLLs and the user-friendly resources currently available. 1) Smart Citizen Water/Soil Station, 2) Kite Aerial Photography (KAP) Foil, 3) Optical Rain Sensor, 4) DIY Wave Gauge. These sensors were carefully selected from the SCORE Sensor Catalogue —located at https://sensors.score-eu-project.eu/ for further details and technical specifications— by the CCLL core team after reviewing workshop outcomes and feedback from stakeholders.

1.2. SCORE Onboarding Platform

Onboarding processes are currently being developed into an online platform for the pilot phase sensors to enable citizens to assemble and deploy sensors independently or as part of SCORE workshops. The onboarding platform will be available to all CCLLs in the coming months and offer clear and concise instructions for citizens when assembling and deploying sensors. The goal is to eventually compile a catalogue of onboarding processes for every sensor available in the SCORE Sensor Catalogue. This includes lists of components required for some sensors, step by step assembly instructions, and troubleshooting techniques to address issues that citizens may encounter and step by step process to register data from the sensor with the SCORE Sensor Things API (STA).

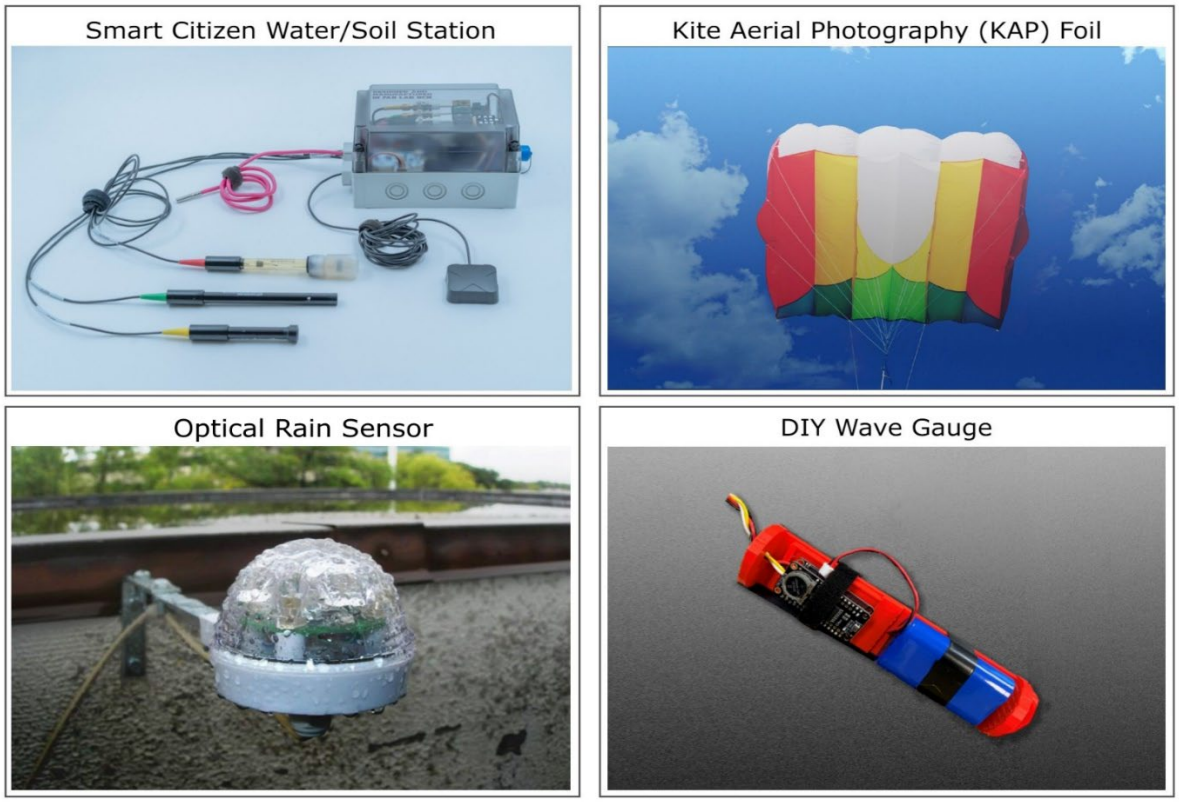

Figure 1 SCORE pilot sensos

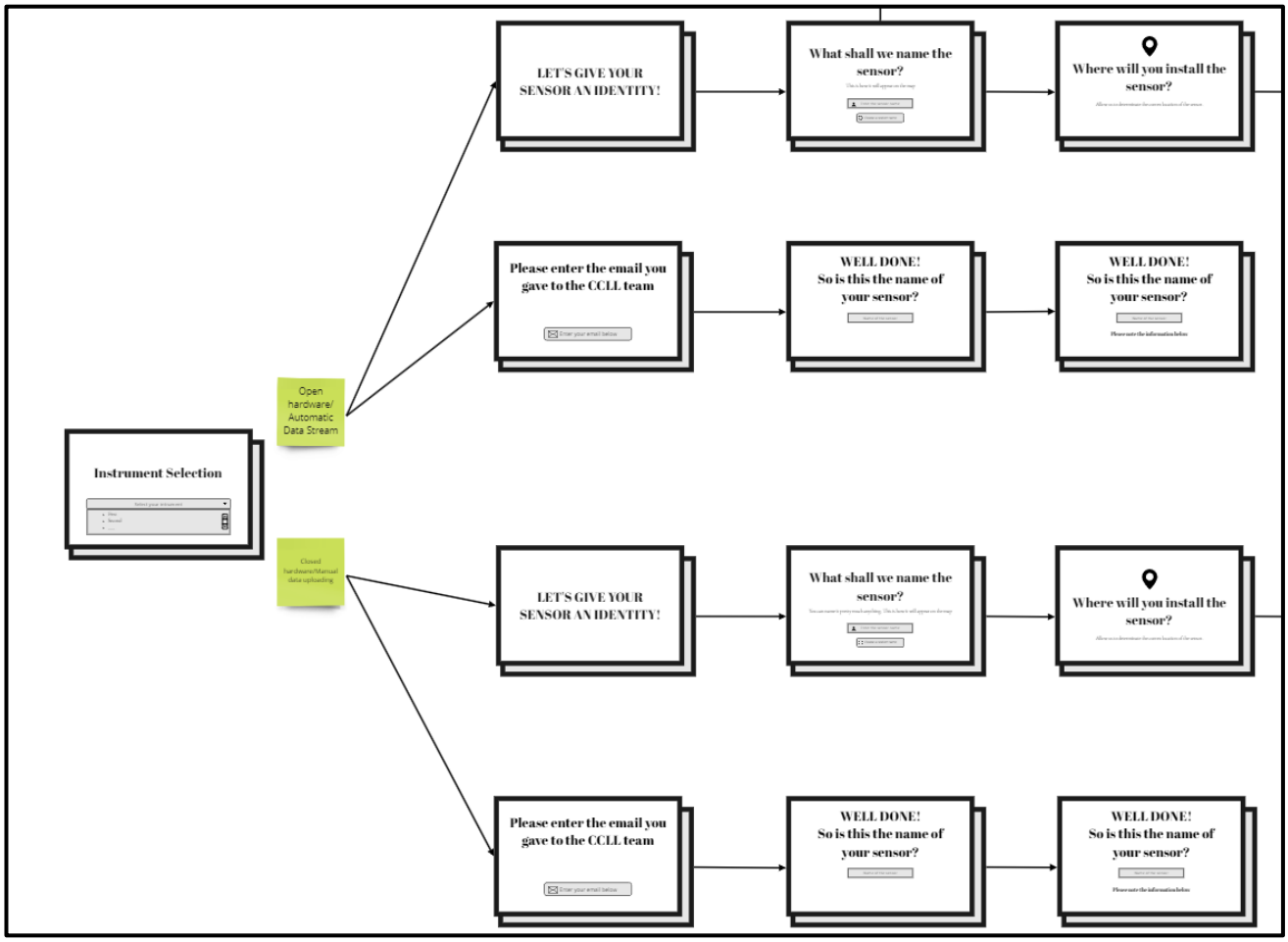

Figure 2. Snippet from Task Miro Board showing flow of actions users will carry out to register data from their sensor with the SCORE STA platform.

1.3. Components

Each sensor used in the project contains varying levels of complexity with some containing fewer components than others. The **Smart Citizen Water/Soil Station** consists of a single unit, encompassing various environmental sensors. While still relatively simple to assemble, the **Kite Aerial Photography (KAP) Foil** involves around six components, including a camera, control mechanisms, and structures for the kite itself. The **Optical Rain Sensor** contains three components consisting of an optical probe, housing for the sensor, and the electronic circuits. Lastly, the **DIY Wave Gauge** requires an abundance of components such as housing for the pressure sensor, the Arduino with the wires, a battery, a power boost, and more depending on the complexity of the requirements.

1.4. Assembly

Some sensors are much easier to assemble than others; however, the SCORE Sensor Things API will provide full step-by-step assembly instructions for each sensor. The **Smart Citizen Water/Soil Station** requires very little assembly as it comes assembled. One will simply connect a cable from the sensor module to the corresponding port on the Smart Citizen Kit main board, and then connect the Smart Citizen Kit main board to a power source via USB.

The **Kite Aerial Photography KAP Foil** is relatively easy to assemble, with no hard frame. One can begin by connecting the kite line to the kite bridle with a clip. The bridle slips into the hook and closes with a hook on the back. Then, after flying the foil with a good breeze, one can let out roughly 100 feet of line and attach the camera. The camera attaches to the kite line at two points with a pivacet. After attaching the camera, the kite line can be let out further.

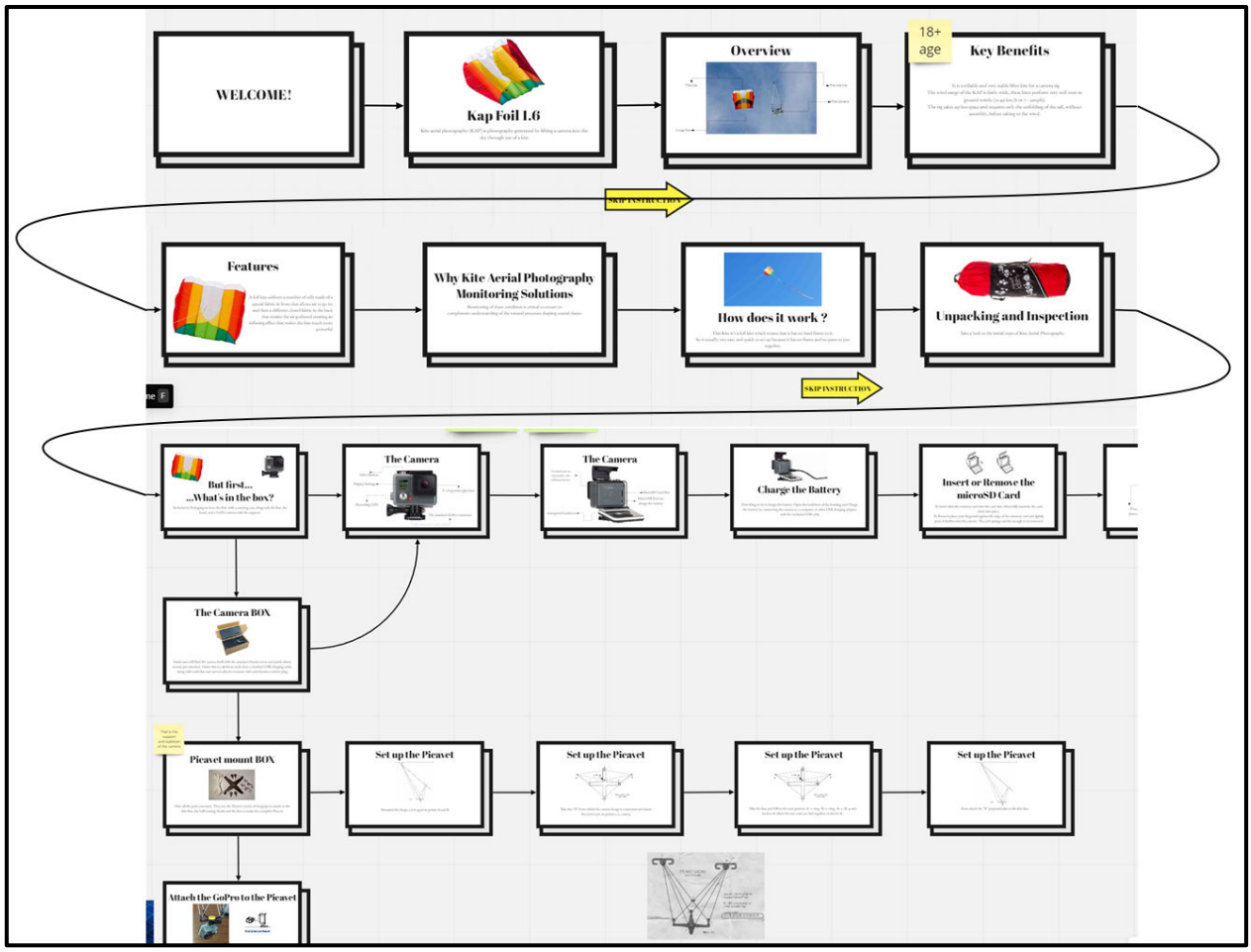

Figure 3 Snippet from Task Miro Board showing flow of actions users will carry out to assemble their Kite Aerial Photography sensor.

The **Optical Rain Gauge** also has relatively easy assembly instructions. The sensor must be driven by a microcontroller (e.g., an ESP32), to which it must be connected with a cable. One will need to identify the necessary pins on the ESP32 for connecting to the rain gauge. Then, one will connect the rain gauge's optical sensor output to a digital input pin on the ESP32 using jumper wires. One will then connect the rain gauge's power supply and ground to the appropriate pins on the ESP32. The overall system must be housed in a box guaranteeing it is watertight against humidity and eventually rain, and it will be provided to the citizens as an engineered and functioning device. Finally, the system must be equipped with a battery and/or a solar panel, in case it cannot connect to the power grid from the location of installation.

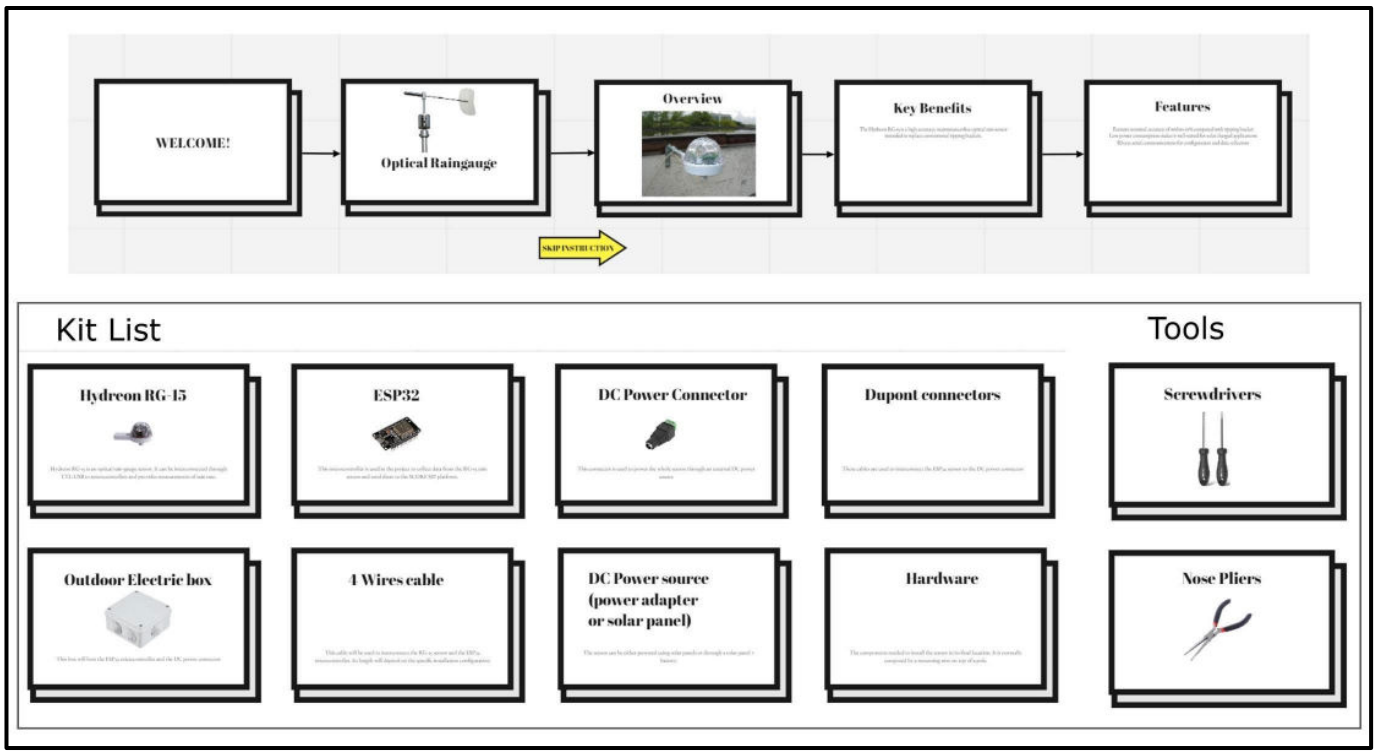

Figure 4 Snippet from Task Miro Board showing flow of actions users will carry out to assemble their Optical Rain Gauge, in addition to required components.

The **DIY Wave Gauge** has a more complex assembly than the other sensors. One will use desiccants on both ends of the housing to absorb any moisture. Then, one will take two cuts of a pool noodle to sandwich the Arduino so that it can be kept secure. Then, run the wire in between the centre and push it to the end of the pipe. Next, one will connect the Arduino to the Pressure Sensor through the Dean's connectors. The battery will reside on the bottom and the power boost on top, attached with velcro. Then, take the Power Cable that will connect the power boost to the Arduino. One will then connect the Jack with the Arduino and the USB plug with the power boost. For the full power, one will connect the battery to the power boost to complete the circuit. Once all of these components are inserted into the wave gauge, one can put the other cut of pool noodle and the remaining desiccants in the open side of the pipe. Lastly, one will take the red cap and twist to tighten and create a seal.

Figure 5 Snippet from Task Miro Board showing flow of actions users will carry out to assemble their DIY Wave Gauge depending upon if the user is a citizen or part of a Living Lab.

1.5. Registration

Some sensors will operate on open hardware or an automatic datastream, while others will operate on closed hardware or manual data uploading. Prior to uploading data, one will select a location for their sensor on the SCORE Sensor Things API. Then, in the case of open hardware—the Smart Citizen Water/Soil Station and Optical Rain Sensor—one will connect a sensor to WiFi and the data will automatically upload to the SCORE Sensor Things API. In the case of closed hardware—the Kite Aerial Photography (KAP) Foil and DIY Wave Gauge—one will have to download data from the sensor's SD card manually and upload it to their computer, which can then be transferred to the SCORE Sensor Things API.

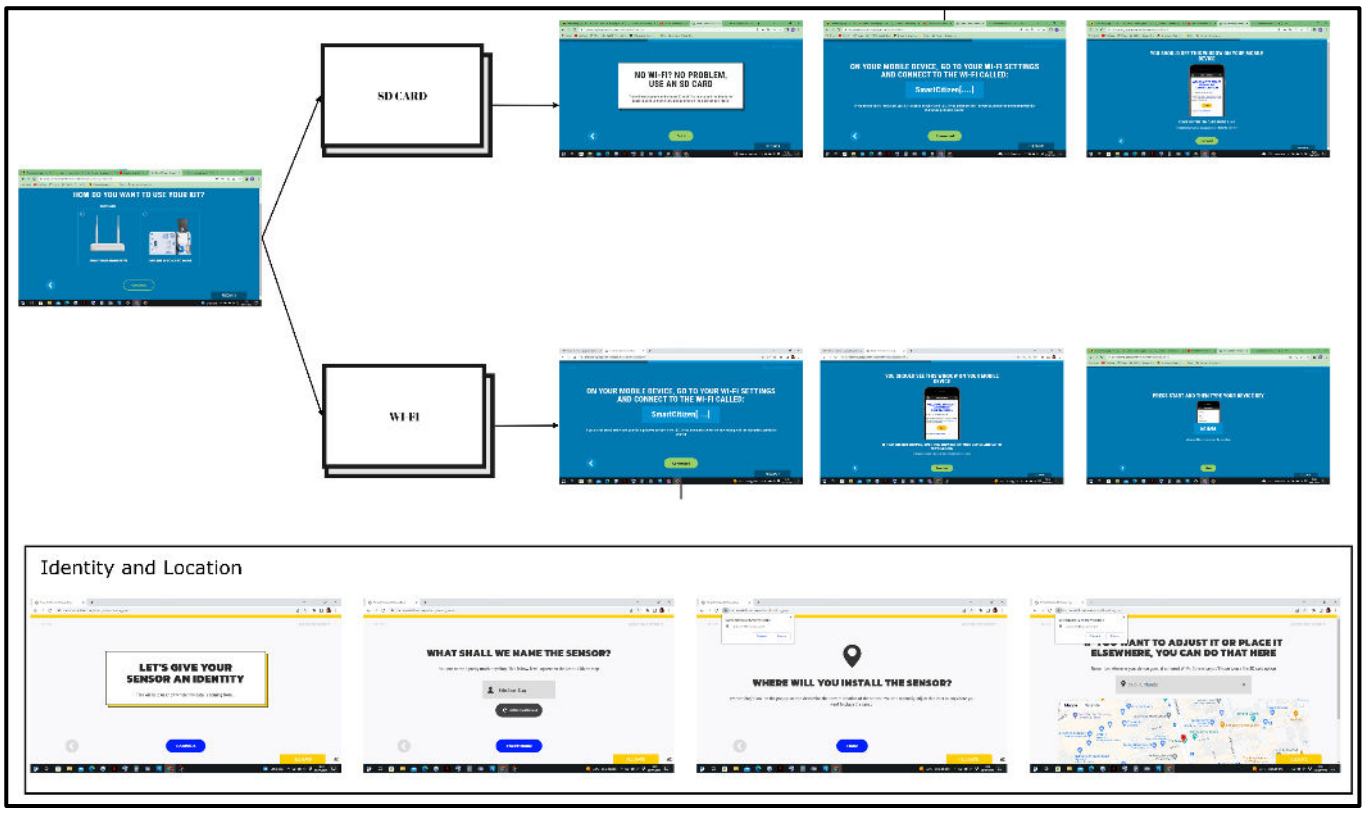

Figure 6 Snippet from Task Miro Board showing registration of sensors, depending upon if it operates on closed or open hardware.

1.6. Deployment

The deployment of the sensors can range from easily deployable to moderately challenging. Some sensors, like the Smart Citizen Water/Soil Station and the Kite Aerial Photography (KAP) Foil, are relatively straightforward and easy to install. These sensors are very adaptable and finding suitable locations should be hassle free. A higher degree of effort is required for installation of the DIY Wave Gauge and Optical Rain Sensors. Wave gauges should be installed offshore at specific depths and optical rain sensors should be positioned for optimal rain exposure. These aspects may require additional expertise and careful planning.

1.7. Troubleshooting

There are a variety of different ways to troubleshoot each sensor. For the Smart Citizen Water/Soil Station, the user should reference the https://smartcitizen.me/ website if they run into any issues and be sure to check the sensor connections and ensure proper power supply. When putting together the Kite Aerial Photography, inspect the kite frame, lines, and control mechanism for any damage or wear as well as ensure proper camera mounting and secure connections. For the DIY Wave Gauge, the high number of components and of the type of assembly can require advanced technical skills; vocational schools and hobby clubs may need to be involved in the assembly phase. The Optical Rain Gauge is dependent on the powering configuration by either connecting to the power grid or using batteries. Users should ensure safe connection if using the power grid. Results may be faulty if the optical probe is not positioned strategically for maximum rain exposure, often requiring drilling a wall to fix the sensor support.

1.8. Sensor Selection Workshops

Using the catalogue of low-cost sensors previously selected under Work Package 4, workshops are being carried out with leading CCLLs of Dublin, Sligo Oerias, Vilanova and Massa. The first of these workshops was held in Dun Laoghaire over the month of May 2023. Representatives of public administration (local authority, utilities, etc.) and academia (UCD, ATU Sligo) from both Sligo and Dublin CCLLs came together to shortlist sensors that address the most pressing hazards in their local areas. The group (c.30 attendees) identified a list of sensors to be purchased with the budget available using the catalogue web platform and identified the stakeholders to be engaged, any barriers, management strategy, etc. The results of this workshop are now being analysed and the CCLL core team will decide on the final set of sensors to be purchased and groups to be involved in their deployment.

Figure 7 Photo from Dublin sensor selection workshop

Figure 8 Photo from Dublin sensor selection workshop

Figure 9 Photo from Dublin sensor selection workshop

1.9. Next Steps

The framework used for DIY citizen science workshops in the SCORE project demonstrates the potential for meaningful public engagement and knowledge creation in scientific research. The selection and deployment of sensors, along with troubleshooting techniques, have been designed to ensure a comprehensive approach to citizen science activities. These workshops serve as valuable platforms for collaboration between public administration, academia, and local stakeholders, fostering a sense of connection and responsibility towards the scientific community and addressing local environmental challenges effectively. Further pilot activities for sensor selection and onboarding are currently being planned with the core CCLL teams in Dublin, Sligo, Oerias, Vilanova and Massa. By the end of these activities, we intend to have refined the sensor onboarding process to enable citizens to actively participate in assembling and deploying sensors independently or through workshops, with the aim to extend this resource to all 10 CCLLs involved in the SCORE project.