

## Deliverable D5.6

# Integrated POSEIDON technology technical documentation

Call:	FP7-ICT-2013-10
Objective:	ICT-2013.5.3 ICT for smart and personalised inclusion
Contractual delivery date:	M38
Actual delivery date:	19.12.2016
Version:	Final
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Dissemination level:	Public
Number of pages:	12

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## 1 Executive summary

This deliverable is a report on the technical documentation of the POSEIDON framework and prototype system. It has two parts. Chapter 2 gives an overview of the integrated technology and system. It serves as a high-level description of the framework and prototypes, and as an introduction to the documentation of this system. Chapter 3 lists the documentation. This gives an overview of the technical documentation, which is mainly found in deliverables and the project website<sup>1</sup>.

Note that this is the final version of an iterative deliverable. Intermediate versions contained various pieces of the actual documentation. The final version of the WP5 deliverables have been restructured for a more cohesive set of documentation. The documentation itself has been moved to other deliverables, and D5.6 has been reduced to a report about the integrated system and its documentation. It therefore retains very little of the intermediate versions.

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<sup>1</sup> <http://www.poseidon-project.org/>

## 2 POSEIDON integrated technology overview

The objective of this chapter is to give a brief description of the complete POSEIDON prototype system, including the infrastructure as well as all prototype applications, to give the reader the overview needed to go into some of the more detailed pieces of documentation on specific parts or aspects of the system.

Starting with Figure 1, this presents the system and services as tested in the second and last pilot. We have three types of users. The primary user, on the right side of the figure, is the person with Down syndrome. This role entails using the system both for training and preparation, and to receive guidance in daily activities at any time. The secondary user enters and configures instructional content and system behaviour, as well as being able to monitor the primary user. The tertiary user role is similar to the secondary user in that it can entail entering content and/or monitoring, but will typically have a more limited access to a whole set of primary users (this could be a school teacher or other form of professional).

Pilot services

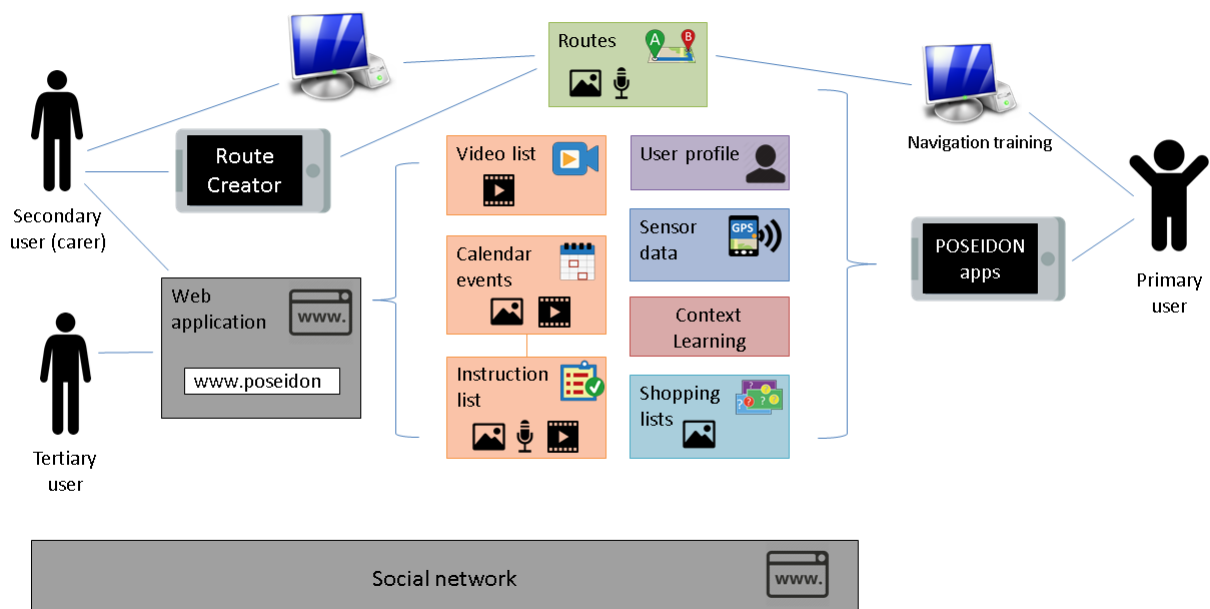


Figure 1: Pilot system overview – users, platforms and functionality

POSEIDON applications are available on three types of platforms: traditional computers (for stationary use), mobile devices and web (running on both computers and mobile devices). For primary users, training has mainly been done on computers while the guidance is otherwise available through apps on the mobile device. For secondary and tertiary users, the POSEIDON web application is the main user interface. Only the navigation-related activities of creating routes and setting up training must be done elsewhere, with computer and mobile app alternatives. A web-site with social network is also an important part of the system, making information available to the users and allowing exchange of experiences.

### 2.1 Shared data

The applications give access to the various forms of data in the system, indicated in the centre of Figure 1. All data is available to all user types, with the POSEIDON infrastructure providing shared storage. Much of the data is instructional content, with media content of images, audio and video indicated with additional icons in the figure.

- Routes: For navigation training and real-time guidance, with text, audio and images.
- Video list: List of private or YouTube videos, for giving instructions to the primary user.
- Calendar events: Time-based content, to notify and instruct on events.
- Instruction lists: A calendar event can have an additional sequential list of instructions.
- User profile: Contains user preferences for personalisation.
- Sensor data: Position and other tracked data is stored for monitoring.
- Context and Learning: Context awareness middleware monitors context information and stores it for learning.
- Shopping lists: Products and shopping lists for money handling training and guidance.

## 2.2 Framework and infrastructure

One of the main results of the POSEIDON project is the developer framework. This is a collection of methodologies, infrastructure, middleware, tools, specifications, etc. which are used in the development of the POSEIDON prototype system and parts of it. This is partly methodologies, open-source code and free tools of general use. But here we are mainly concerned with the POSEIDON infrastructure. It is what binds our applications together in a system, and it also allows new applications to integrate with this system. A goal of the POSEIDON project is to foster development of inclusive services for people with Down syndrome, and a commercial POSEIDON solution needs to be extensible with new services. The development framework is the project's way of addressing these goals.

### Framework architecture

### Infrastructure components

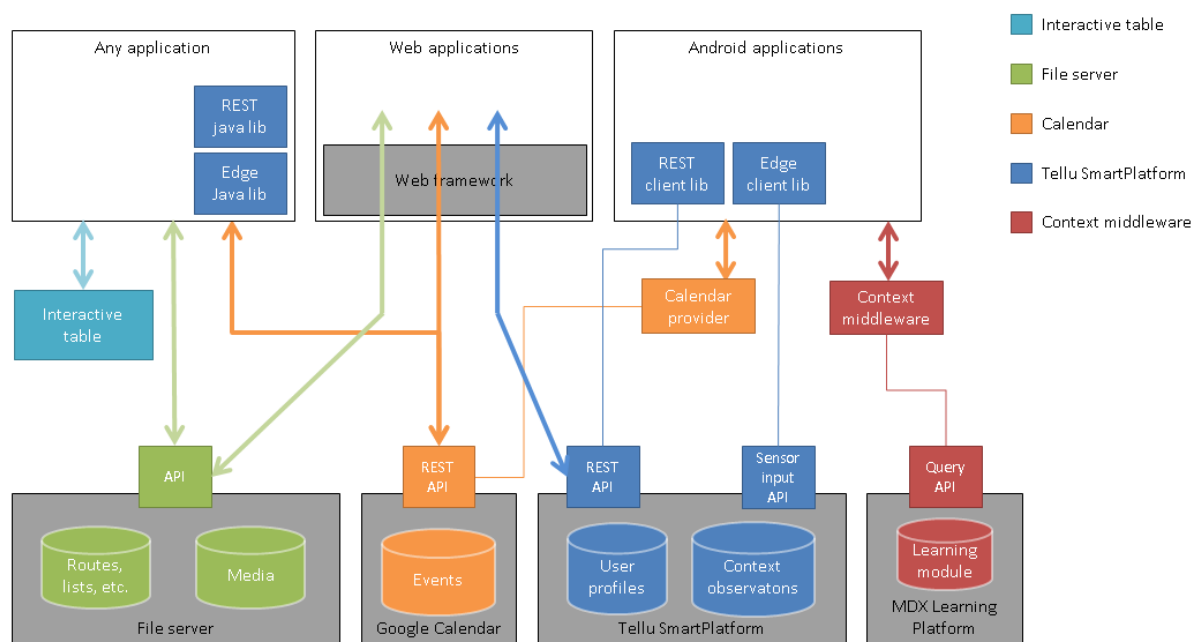


Figure 2: POSEIDON framework architecture and infrastructure

Figure 2 shows the framework architecture with infrastructure. The server-side parts of the system are shown along the bottom, with the data stores. There is a calendar server, while a file server stores the rest of the instructional content and media. The SmartPlatform server holds the POSEIDON accounts with user profiles along with tracked data for monitoring. Any POSEIDON application can connect to the infrastructure and access the data, as long as it has authentication as a registered user. The Learning Platform holds context data for learning. It is connected to context middleware running on the mobile device.

Middleware running on devices is another part of the infrastructure, and also includes calendar data synchronisation. The context middleware provides context awareness to mobile applications, using the sensors of the device as well as external services to monitor context. Context considered includes location, time, weather, battery capacity, user preferences etc. Applications can subscribe to context updates from the middleware, and also post their own context observations to the middleware.

The boxes in the top part of the figure indicate applications connected to the infrastructure, showing some of the components we provide for building such applications and connecting them to the infrastructure. Android is the primary mobile platform, with specific components provided, while we have also produced Unity and Java components of a more generic nature. A set of technologies and code forms the basis of the POSEIDON web application, and this can also be reused by others.

## 2.3 Prototype system

Figure 3 provides a third view of the integrated system, this time showing all the main components of the final prototype system and how they are distributed. The servers of the infrastructure take up the middle part of this figure. Connected to this are the three types of applications – stationary (computer), mobile (phone/tablet) and web – with their functional components. This shows how the different functional aspects (colour-coded in the figure) are distributed throughout it. Note that the colour-coding is different from that of Figure 2.

### Pilot 2 components

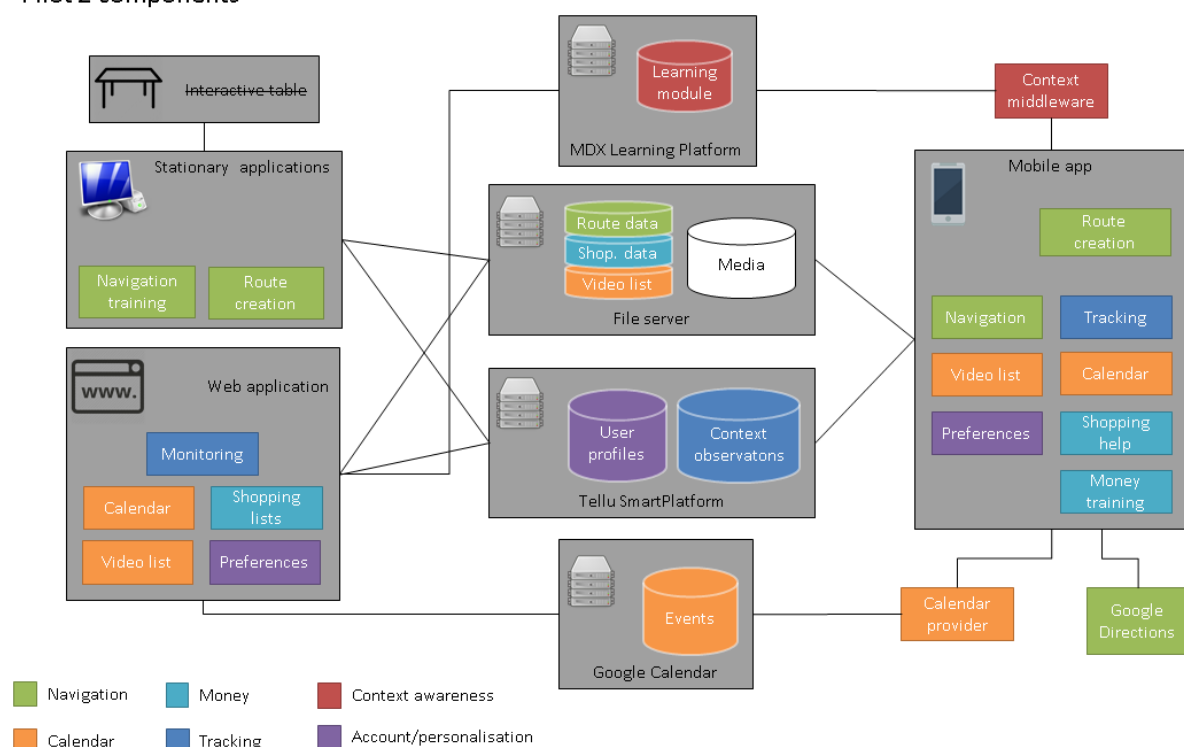


Figure 3 – Overview of POSEIDON final prototype system

Not all prototypes have been included in the final pilot system, most importantly the interactive table. The interactive table has been a central focus in the project, tested in the first pilot and considered a part of the infrastructure for stationary applications. It is a prototype of a new interaction device, which combines the size of a multi-touch table with 3D hand position recognition. It is intended to be unobtrusively built into tables, allowing the user to control applications via hand gesture on or over the table. It can be part of the stationary system, used to control training applications for navigation and money handling.

Looking at some of the colour-coded functional aspects, green is for navigation – the guidance related to space. The home system part is used by carers to create personalised routes, and by primary users to train with virtual reality. Routes and instructional media are stored on the file server. Route creation can also be done by walking the route with a mobile application. Navigation guidance is provided on the mobile device, tracking the user on a trip. While the main routes are created by carers to be personalised for the primary user, the mobile application can also use the Google Directions service to find the way back to the main route if the user gets lost.

Support for the use of money is likewise distributed throughout the system, shown in cyan in the figure. Products to buy, and shopping lists based on these, are defined using the web application and stored on the file server. Training money handling based on the shopping lists was initially provided on the stationary system, using the interactive table, but was moved to the mobile system for the second pilot. The mobile application provides the aid the when out in the shop.

Orange highlights the assistance related to time – the calendar-based functionality. The web application has a calendar interface, for managing events and connecting them to functionality such as navigation. The mobile application also has a calendar interface – a simpler interface better adapted to the smaller screen and primary users, but also allowing entering basic events. And the mobile application provides reminders. All calendar-based functionality connects to the same cloud storage of events. The events themselves are stored in Google Calendar, but the POSEIDON-specific extension of the calendar supports lists of instructions, and media stored on the file server. Included in orange is also the possibility of defining a list of instructional videos in the web application, which is stored on the file server and provided to the primary user on the mobile device.

### 3 Technical documentation

This chapter gives an overview of the technical documentation produced in the project, documenting the prototypes and framework. Most documentation is included in our project deliverables. All public deliverables, as well as other forms of documentation, is published on the project website.

#### 3.1 Technical deliverables

Here we list all deliverables in the technical work packages (WP3, WP4 and WP5), with brief descriptions of the final content of these documents. In addition, deliverables in WP2 (Requirements, Design and Impact) and WP6 (Validation) have some relevance for the technical work.

	Title	Description
<b>WP3 – Context-Awareness</b>		
3.1	Ontology and Language	Describes context ontology and definition language for the context awareness middleware.
3.2	Reasoning and Learning module	Iterative deliverable documenting the work on learning and reasoning within the POSEIDON project. This is the primary documentation of the context middleware. It describes reasoning models and the middleware architecture and implementation.
<b>WP4 – Human Computer Interaction</b>		
4.1	Interface strategy	Outlines the user interface strategy for the POSEIDON system, and is a resource for user interface developers. Documents the different iterations of UI work in the project.
4.2	Adaptive tablet interface	Presents our work on adaptivity in the user interfaces. It describes adaptivity and personalization in the pilots, and the user interface of the main POSEIDON mobile application.
4.3	Interactive table	Describes the interactive table – the novel input method developed in the project and used with some of the applications – including prototype implementations and communicating with computer applications.
4.4	Virtual Reality System	Discusses use of Virtual Reality in the POSEIDON solution, and the prototype implementation, which is mixed reality navigation training.
4.5	HCI user and developer manuals	Documentation on user interface design and implementation. User manuals for pilot 1 and pilot 2 applications are included in this deliverable, along with developer documentation for user interface implementation.
<b>WP5 – System Integration and Services Development</b>		
5.1	Development framework	The main documentation of the framework for developers. It documents our work with defining and selecting the methodology and technology components of the framework. Framework requirements are analysed. Methodologies and technical architecture are described in detail, as are infrastructure, developer tools and software components. Technical details such as API specifications are found in D5.4.
5.2	Prototypic systems of the POSEIDON concept	Describes the integrated prototype systems produced in the project. It describes the developments in each prototype iteration and the functionality in the two pilots, giving an overview of the system as a whole. It also includes technical



		documentation for components not part of the framework or documented elsewhere.
5.3	Guidance repository	Describes the instructional material in the POSEIDON system, and includes a guide for end users to make instructional videos.
5.4	Databases for integration of services	A collection of developer documentation for the data specifications and sever-side APIs of the POSEIDON framework, providing data storage and exchange.
5.5	POSEIDON social network for carers	A pre-study reporting on how to implement a social network for POSEIDON.
5.6	Integrated POSEIDON technology technical documentation	Report giving an overview of the technical results and the documentation produced.

A note concerning D5.1 and D5.4: These together contain the technical documentation of the developer framework. They were not iterative deliverables in the original Description of Work, with final deliverable dates in the first year. As the process of defining a framework has been an iterative one, alternating with prototype development, they needed to be updated throughout much of the project, which is reflected in the revised DoW.

### 3.2 End user documentation

Various forms of documentation have been produced to instruct users how to use the various applications in POSEIDON, mainly for the versions used in the two pilots. Much of the text-based documentation is collected in deliverable D4.5, for both pilot 1 and 2. See section 7.1 for an overview of user manuals for pilot 2. Both documents and instructional videos are published on the project website. Here we summarise the final state of the documentation.

Application	Documentation	Where
Home Navigation System	<b>Home Navigation System (HNS) for pilot 2</b> is a brief user manual for the secondary user role of editing the routes for training. <b>Instructional videos</b> explain the training, and are available in all three languages.	D4.5 Web
POSEIDON web	<b>POSEIDON Web User Manual for pilot 2</b> explains how to use the web, managing calendar with instructions, shopping lists, video list and monitoring. A number of <b>instructional videos</b> for using the web have also been produced.	D4.5 Web
Main mobile app	<b>POSEIDON app technical user manual</b> is a comprehensive documentation for the main Android application, with navigation, calendar, video and preferences. The pilot 2 version is in D4.5, while an up-to-date final version is available from the project website. An <b>instructional video</b> is also on the web.	D4.5 Web Web
Shopping app	<b>POSEIDON shopping app user manual for pilot 2</b> explains how to install and use the shopping app.	D4.5 Web
Moneyhandling Training app	<b>Moneyhandling Training App - User Manual for pilot 2</b> explains how to install and use the training app for phone or tablet.	D4.5
Moneyhandling Training (CapTap)	This is the moneyhandling training application for use with the interactive table (Not used in pilot 2). <b>Money handling</b>	Web

	<b>application with CapTap</b> is the user manual for secondary users. An <b>instructional video</b> is also on the web.	Web
Context middleware	Users do not interact directly with the context middleware when operating the system, but it needs to be installed and there are settings which can be configured. <b>Context Settings User Manual for pilot 2</b> documents the configuration user interface.	D4.5
Route Creator app	<b>POSEIDON Route Creator app user manual</b> is the user manual for the secondary user mobile app for creating routes.	D4.5 Web
Social Network	<b>Poseidon guide for social media functionality</b> explains how to use the social network website.	D4.5 Web

### 3.3 Developer documentation

All WP 3, 4 and 5 deliverables are more or less relevant for developers. Most technical documentation is also included there. While all public deliverables are published on the project website, we have also published documents more directly targeted at developers. Aspects and features considered as part of the POSEIDON developer framework are primarily what developers will be interested in. Deliverable D5.1 gives the overall description of this framework, and is a good starting point to get an understanding of what the framework contains. In the table below we summarise documentation for specific components of the framework. All documentation is available online, from the project website unless stated otherwise.

Component	Documentation
Methodologies	
UC-SDP	User Centered Software Development Process: D5.1 ch.3.1.
Ethical framework	Ethics in POSEIDON pdf. D5.1 ch.3.2 + 3.3.
R4C-AS	Methodology for requirements elicitation in Context-Aware Systems: D5.1 ch.3.4.
Infrastructure	
SmartPlatform	Overview in D5.1 ch.5.1. Developer documentation & API pdf (also D5.4 ch.2). Online documentation: <a href="https://smartracker.no/documentation">https://smartracker.no/documentation</a>
File server	Overview in D5.1 ch.5.2. API documentation pdf (also D5.4 ch.3).
Route data	Data specification pdf (also D5.4 ch.4).
Shopping lists	Data specification pdf (also D5.4 ch.5).
Video list	Data specification pdf (also D5.4 ch.6).
Calendar	Overview in D5.1 ch.5.3. Developer documentation pdf (also D5.4 ch.7).
Context awareness middleware	Overview in D5.1 ch.5.4. Details in D3.2.
Interactive table	Interactive table (CapTap) – API pdf. Programming documentation in D5.1 ch.6.6. Details on implementation in D4.3. Deployment User Manual for developers in D4.5 ch.5.7.
Developer tools and components	

Tool Support for R4C-AS	Tool documentation in D5.1 ch.6.1.
Context modelling	Tool documentation in D5.1 ch.6.2.
Android	Overview in D5.1 ch.6.3. Android User Interface Implementation described in D4.5 ch.4.
Web framework	Overview in D5.1 ch.6.4. POSEIDON web developer manual in D4.5 ch.8.11.
SmartPlatform client libraries	Overview in D5.1 ch.6.5. Documentation included in libraries available from project website.
Unity library	Documented in D5.1 ch.6.7.
User interfaces	Design guidelines and methodology: D4.1 ch.5 and 6. POSEIDON UI design/elements: D4.1 ch.7 and 8. Adaptive aspects in POSEIDON: D4.2.

### 3.4 Project website

The project website is our most important dissemination channel. Most of the documentation, both for end users and developers, is available here (the only exception is deliverables with a confidential dissemination level).

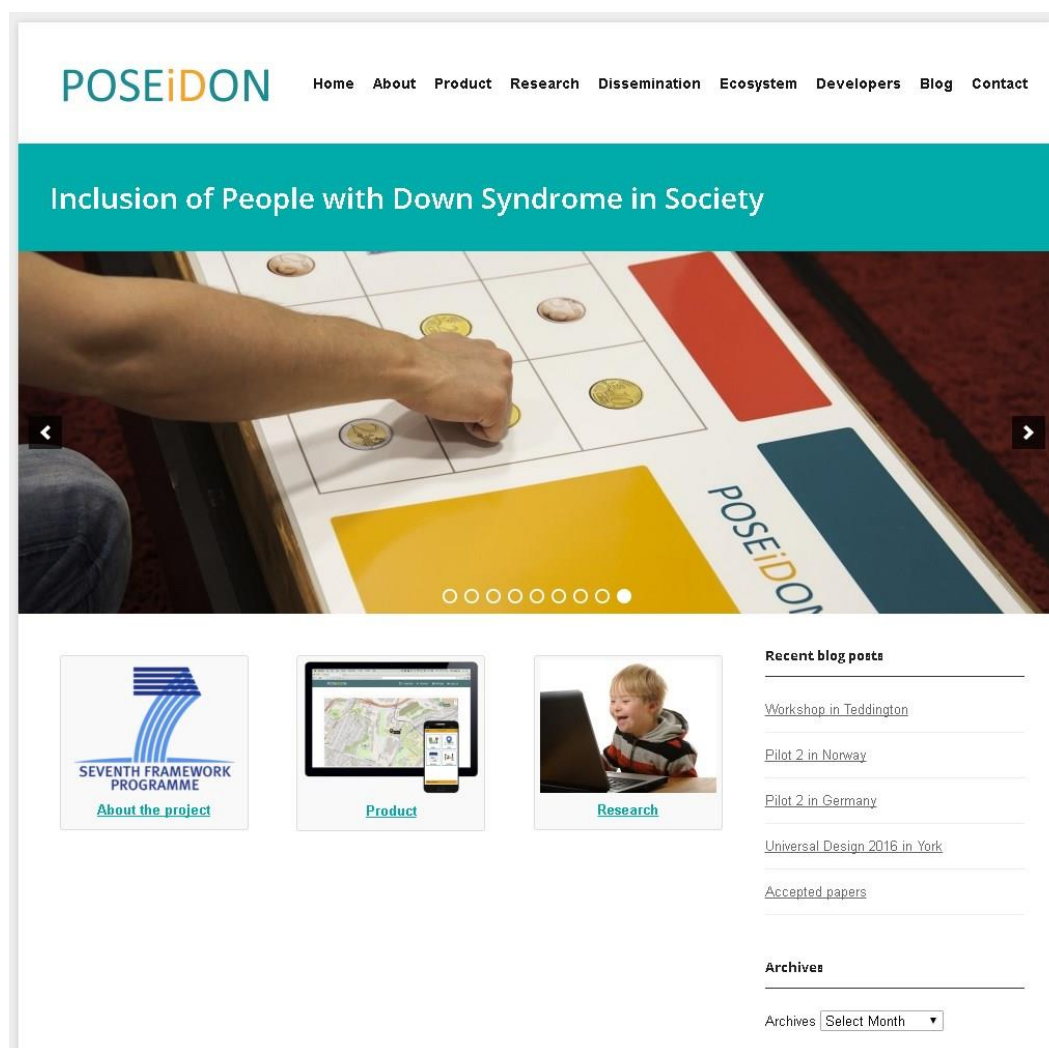


Figure 4: POSEIDON project website

Website address: <http://www.poseidon-project.org>

In addition to documentation downloads, the website presents all the aspects of the POSEIDON system in a brief manner. It currently has the following sections:

- About: Presents the POSEIDON project.
- Product: Describes the prototype applications and services. End user documentation is found here.
- Research: Describes the project activities and achievements. Public deliverables are found here. Of the deliverables described in this report, only D5.2 is not public.
- Dissemination: Describes the project's dissemination, including scientific publications.
- Ecosystem: Describes the idea to build an ecosystem where the POSEIDON results are one part.
- Developers: Presents the POSEIDON developer framework. Downloads for code components and documentation is found here.
- Blog: Blog about project activities.
- Contact: Information about participants.