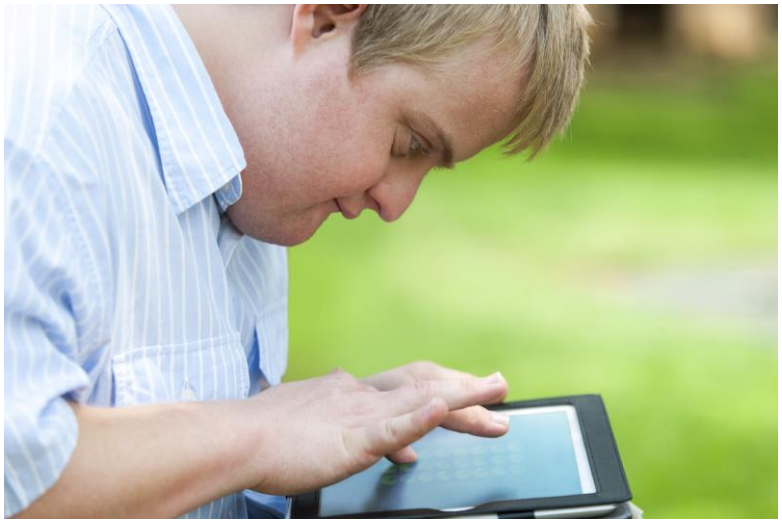
POSEiDON

Pers**O**nalized **S**mart **E**nvironments to increase **I**nclusion of people with **DO**wn's sy**N**drome

New Report R2

Personalisation in POSEIDON



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Executive summary

The purpose of this document is to present the personalisation mechanisms in the POSEIDON-system. Personalisation in POSEIDON is anchored in the fundamental end user needs and preferences of POSEIDON's target group: persons with Down syndrome.

Personalisation has been an important issue since the inception of the project. Personalisation in POSEIDON means that we are aiming to meet the needs of the individuals in ways that are comfortable and easy to use for them and therefore provide a good user experience. The abilities may vary significantly for people with Down syndrome. For the primary end users, the personalisation may also mean ordinary ICT-related accessibility and implementation of special features to meet their abilities in best possible ways.

The primary end-user and the carers can do the POSEIDON personalisation. The primary end user can do fairly simple personalisation tasks at the mobile device.

We provide a POSEIDON personalisation web. Through this, the carer, often family carers but also formal carers and other stakeholders, can configure the whole POSEIDON system to the benefit of the individual primary end user.

The carer can produce content for the POSEIDON system in form of symbols, pictures, photos, videos, sound and text. The carer can define routes for the navigation app and can augment the route with illustrating pictures, photos, text and spoken messages. The calendar is an important reminder and communication service for the primary end user in POSEDION. The carer can define the elements of the calendar and how it should be presented for the primary user, depending on the primary user's skills and abilities. The carer can give additional information to each event in the form of photos, videos and text, e.g. a video showing how to pack the school bag for tomorrow or a reminder to wear warm clothes if the weather is cold.

In POSEIDON, we strived for realisation of accessible solutions on all POSEIDON platforms (web, apps on smartphones or tablet PCs etc.). Accessibility can be viewed as the "ability to access" and benefit from some system or entity. The concept focuses on enabling access for people with special needs, or enabling access using assistive technology. We provided colour palettes and a set of symbols and icons for persons with learning disabilities. This way, we make it easier for the carer to personalise the POSEIDON services to fit the abilities of the user.

The POSEIDON developer framework provides support for individual personalisation of services.

1 Introduction

The main objective of the POSEIDON project is to exploit ICT as an instrument to increase the quality of life and support a more independent life and inclusion in the society for people with Down syndrome.

The purpose of this document is to present the personalisation mechanisms, including the context awareness features in the POSEIDON system, to present the anchorage of these in the scientifically documented user profiles and learning capabilities of people with Down syndrome, and finally to draft the additional options for personalisation of POSEIDON. This document should be studied together with the Developer Guide at the POSEIDON web site http://www.poseidon-project.org/introduction/ in order to fully understand which personalisation support is offered by the POSEIDON framework.

This report has also a connection to the design guideline of POSEIDON, also described in the Developer Guide. The purpose of the POSEIDON design guidelines was to kick off the prototype development with "family resemblance" between the different parts of the system, and to create a minimum level of visual clarity embedded in the first versions of software for end users. The look and feel of the POSEIDON family of apps have been well received.

In addition to the POSEIDON approach to personalisation as explained in the reminder of this document, the end users should familiarise themselves with accessibility and personalisation options that are provided by software and hardware providers [1], such as browser accessibility, and device accessibility features, and for example different sets/systems of symbols (MAKATON[2], Boardmaker[3], PECS, Clicker[4], Widgit[5]) that support people with reading and learning difficulty. These are not covered in this report.

Evaluation results on personalisation in POISEIDON are given in section 2.2 of this document. Most of the pilot participants were content with the personalisation options which were provided, but some suggestions for improvements are also given.

2 Personalisation for users with Down syndrome

2.1 Intellectual capability of people with Down syndrome

Personalisation in POSEIDON means we are aiming to meet the needs of individuals with Down syndrome in ways that best suit their learning profile and ensures an optimum user experience. The abilities may vary significantly for people with Down syndrome. For the primary end users, the personalisation may mean ordinary ICT-related accessibility and implementation of special features to meet their abilities in best possible ways.

In particular, we are focussing on an interaction design that takes into consideration the target group's requirements that relate to vision, fine motor abilities and intellectual ability (especially reading, writing, and comprehension). These are well explained in publications and on specialist websites that offer Down syndrome-specific knowledge, for example www.downs-syndrome.org.uk. Below, a short resume:

[1] E.g., accessibility features of Windows: http://windows.microsoft.com/en-us/windows/what-accessibility-features-windows-offer#1TC=windows-7&section_2

[2] http://www.makaton.org/aboutMakaton/

[3] http://www.mayer-johnson.com/boardmaker-software

[4] http://www.cricksoft.com/uk/products/clicker/home.aspx

[5] http://www.widgit.com/symbols/ and Communicate in Print (using Widgit symbols) http://www.widgit.com/products/inprint/index.htm

The following learning characteristics can be considered typical of most children with Down syndrome[6]:

- Visual learning style – visual processing and visual memory skills are strengths.
- Reading is usually a relative strength, compared to oral language.
- Number can be an area of difficulty; focus should be on functional maths that is useful for everyday living
- Social understanding and non-verbal communication are strengths.
- Hypotonia – reduced muscle tone causes difficulties in movement control (both fine and gross motor skills can be delayed).
- There is a significant risk of auditory and/or visual impairments, around 50 % of children with Down's syndrome have some form of hearing impairment (sensorineural hearing loss and conductive hearing loss) and about 70 % of children with Down syndrome need to wear glasses by the time they start school. Even with corrective prescription individuals with Down's syndrome have difficulty focuses 'at near'.
- Specific speech and language profile – receptive language is usually superior to expressive language.
- Auditory short-term memory and auditory processing an area of weakness. Auditory memory difficulties should be compensated for by the use of visual supports and prompts wherever possible (signs, pictures, words).

There is also a list of implications from the learning profile at the same website[7], the most important for POSEIDON being the above-mentioned auditory memory weakness. More profound explanation on these aspects can be found in Down Syndrome Education International[8]. The importance of paying appropriate attention to learning styles and adaption by people with Down syndrome is additionally underlined by Down syndrome learning expert Sue Buckley in her publication 'Meeting the educational needs of children with Down syndrome: Keys to successful inclusion'[9].

Implications of these for POSEIDON are considered in the selection of personalisation and context awareness features and the design of these, as explained in the remainder of this document.

2.2 Personalisation in POSEIDON

In a nutshell, personalisation in POSEIDON is about considering the following knowledge about the end users, people with Down syndrome:

Challenges

- They are often visually oriented end users.
- They may have visual and hearing impairment.
- They may have difficulty with fine motor skills.
- They may have difficulty with the short-term working memory.
- They may have difficulty with learning, conceptualisation, abstract thinking and problem solving.
- They may have a reading difficulty, and some do not read at all.
- The may have difficulty in the application of existing knowledge in new situations/contexts.

Strengths

[6] Down Syndrome Ireland http://www.downsyndrome.ie/typical-learning-profile-of-a-child-with-down-syndrome/
[7] Down Syndrome Ireland www.downsyndrome.ie/implications-of-learning-profile/
[8] Development and learning http://www.dseinternational.org/en-us/about-down-syndrome/development/
[9] http://www.nfer.ac.uk/nfer/PRE_PDF_Files/02_28_01.pdf

- They can master many activities of daily life with appropriate support or through repeating training over an extended period.[10]
- They are often clever users of information technology such smart phones and tablet PCs.

In the various pilots and workshops of POSEIDON, one of the aims was to find out if the functions of POSEIDON are sufficiently adaptable to the needs and abilities of persons with Down syndrome. Therefore, we asked the Secondary Users if they were able to personalise the apps sufficiently to the abilities and needs of the person with Down syndrome. We wanted to know which functions they personalised for the person with Down Syndrome. Furthermore, which other functions should be personalised.

For every POSEIDON application, there are possibilities to customize it to the abilities and needs of the person with Down syndrome. The SUs were asked in the interviews what they personalized and if other functions should have the possibility for personalization.

All in all, the SUs were quite confident and personalized a lot. However, they suggested many ideas of improvement for further development.

Regarding the ***POSEIDON web*** nearly all SUs indicated that they were able to customize it sufficiently to the abilities and needs of their children. They customized for example the screen settings of contrast, the alerts on calendar and routes linked to calendar. The SUs used text that the PU would understand, added links to videos the PU liked, and made shopping lists with products they are familiar with.

As an improvement for the ***calendar*** it was suggested that there should be a possibility to change from a 24-hour to 12-hour clock with an icon of a sun or moon to indicate if it is evening/night or morning/daytime, because the 24-hour digital clock was often too difficult for PUs. Also, if the PU inserts an appointment via app it should be possible to choose pictures or sign/symbols from a list, if the PU is not able to write. If SUs add pictures, links to videos or instruction messages, they should be able to decide how large the window for the picture, video or text should be (for example full screen) accordingly to the needs of the PU.

Moreover, most of the SUs would like to know what weather information messages the PU will receive and to be able to personalize these messages. The weather notification should also not disappear that fast and should be retrievable. The font should be adjustable as well. This was implemented for the final version.

For the ***video instructions,*** there should be a more visual view of the videos linked to in the app, and not a list of Video 1, Video 2, etc. For example, there could be thumbnails with the title of the video. In addition, it should be possible to decide which videos should be streamed when using mobile network or not. Now you can only select to stream all or none of the videos.

At the beginning of the second pilot in Norway and in the UK Google Street View was used in the ***Home Navigation System.*** The SUs suggested to remove Google Street View, and it was done, so that they could use their own photos (which are more up to date and taken from a more correct angle than StreetView) only. Although it was more effort to take photos, the SUs liked the possibility because the angle of Google Street View (in the middle of the street) was sometimes confusing for the PUs. As an

[10] This is very relevant, especially if we keep in mind that personalisation is always possible to change; either it can be less, because the end users trained a certain skill with the system and do not need anymore all personalisation. One example is fewer steps in the calendar instruction lists, or making the calendar prompts appear closer to the event.). Similar learning may also apply for the reading process where symbols are not necessary anymore, more words can be used, or it is enough just to show the back bag and not anymore *what* to pack. This is about increasing skills through POSEIDON, not becoming dependent on POSEIDON. Observing the development is an important task of the secondary user in order to adapt the personalisation to the right level. This can change during the usage of POSEIDON.

additional possibility to personalize it should be possible to get an audio instruction next to the writing in the HNS.

The SUs personalized the ***navigation*** through the route creator app by adding own pictures of decision points and instructions. The images in decision points should be larger or "zoomable" because the PUs did not see all the important details in some of the images. Moreover, there should be a message saying that the route has ended. SU could insert an own advice such as: "You have arrived the destination!" or "You are finished". This was implemented for the final version. Ideally, the SUs wish to track the PUs inside for example of shopping malls, etc. For some PUs the map was a bit abstract, especially when the map is viewed from above and there is no arrow showing which direction to walk. A map with a more realistic view should be available.

There is only the possibility to change the products and prices in the ***Money Handling app*** for personalization. To provide other/more learning levels would give the possibility to customise it more to the individual needs. Moreover, it would be good to have the possibility to decide if bills are necessary or not, or other coins are needed. For money learning beginners, this could be helpful. In addition, it would be nice to get feedback when paying too much for the product, not only the symbol for getting change. And there should be an acoustical feedback to try again.

These are some examples for aspects related to personalisation that can be improved when interacting with the primary and secondary users during the development phase. It is highly recommended to engage in this activity during the development process.

3 Technical means for personalisation in POSEIDON

In order to understand personalisation in POSEIDON, we first define by who it can be performed. This can be:

- **Primary end users**: Primary end user's own choices for example on the smartphone. Examples are use of voice output, and tracking (on/off), as both practical matters as well as those of self-conception and contact with parents/carers.
- **Carers**: POSEIDON web for management and personalisation of primary end user's applications.
- **End users and carers together:** The colour palette is an example of choices that can need to be set up in collaboration as it is about comparison of alternatives where the primary end user must select the best choice for her/him. (NB: Changing the colour palette by end users themselves is an option. For example, if the weather conditions are changing and the light is suddenly different, that the primary end user may want to change the contrast. Only a few end users would need help to do this.)
- **Carers, formal or informal**: Much of the personalisation is the responsibility of the carer (such as creating lists, recording spoken messages, creating video clips etc. The POSEIDON family of apps is being built active use of contextual information in order to improve the user experience, safety and privacy of the end user. It may be connected to such parameters as location, identity, activity/task, time and the device itself. These parameters must be set by the carer.

  Carers must not necessarily be family carers, but can be teachers or supporting people or other helpers in institutions, or any other stakeholders who are involved in the caring or daily activity of the person with Down syndrome.

The personalisation aspects of POSEIDON can further be divided into three main categories: personalised content, preferences for apps, and other mechanisms (external to POSEIDON, like phone stings). For personalised content, we have routes, calendar events and instructions, shopping lists, and

video lists. For each of these, we in this document illustrate what content these can have (cf. the numbered list below). Media, including symbols, is an important part of this. It is important to note that interaction with content is always done in more than one application, so content is not tied to a specific app.

All POSEIDON services may be personalised. Content is usually set up by the carer before the person with Down syndrome should use an app for a specific task. Preferences are of more permanent nature, that could e.g. be the look and feel of the app family. It should be the PU's choice. Tests show that most of the PUs are indifferent regarding choice of look and feel. Configuration is about setting up the POSEIDON system, and is normally performed only by start up the first time by the carer.

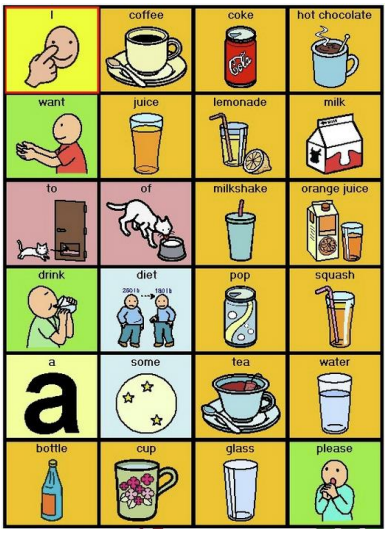
Below, we present the main personalisation options that have been implemented.

3.1 Content-related personalisation

1. **Supportive symbols in calendar events**: Some persons with Down syndrome have low reading ability. Multimodality is one of the cornerstones of the personalisation in POSEIDON. Carers who insert the events in the calendar may add symbols that for example bring the end user to supportive functionality, such as lists, videos etc.:

Symbols can be selected either from the POSEIDON's own symbol repository, or other symbol sets, e.g. pictograms that are commonly used for symbol *writing,* specially designed for communication with persons with intellectual disability[11] such as Makaton, Boardmaker, PECS or the like:

[11] http://talksense.weebly.com/symbols.html



Uses of these types of symbol libraries require licence with subscription and are subscribed by schools and other institutions dealing with children/pupils with special needs.

Some end users need symbols, and other 'easy-to-read'-assistance. For some POSEIDON end users, easy-to-read text combined with POSEIDON symbols may be a sufficient solution (Easy-to-read is something for all people with learning problems[12].)

Carers who insert in the calendar appointments can also personalise the text items by choosing to write the text in 'ALL CAPS' and/or use dashes in long words, all depending on the reading ability of the person they are caring for.

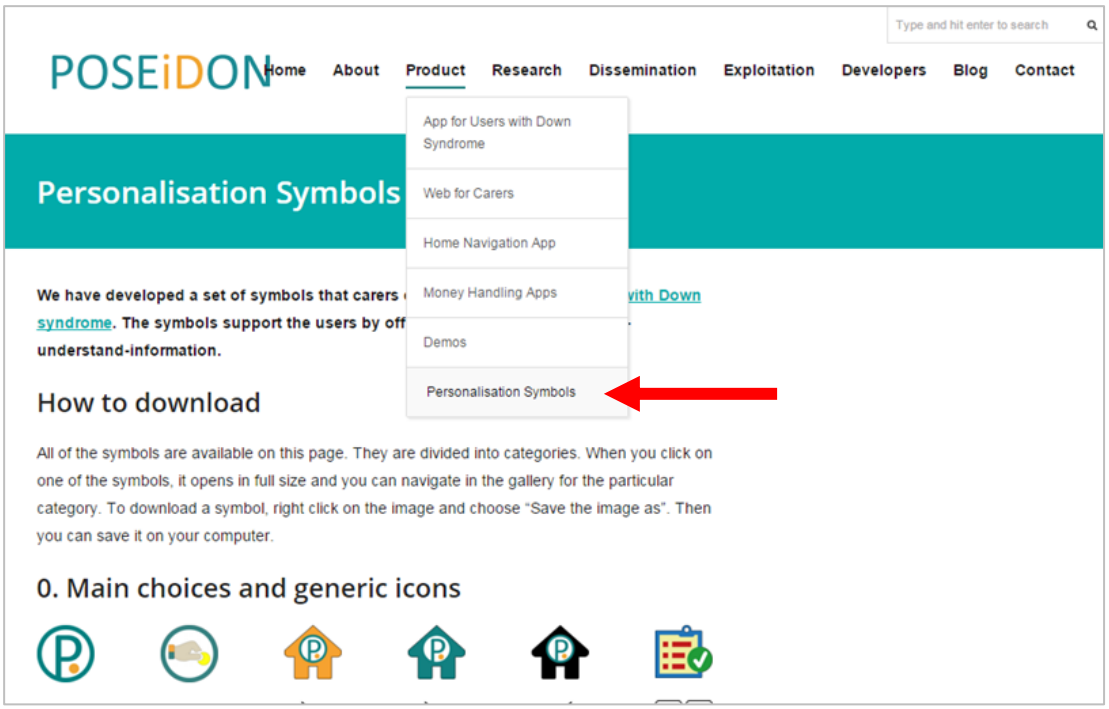
It is also possible to add video content to the apps as shown later in this document.

2. **POSEIDON's own symbol repository** has been developed to support carers' personalisation effort without access to licence-based libraries (above-mentioned). The use of the symbols can be manifold, from diverse calendar functionalities to different lists etc. Currently, the repository includes 8 categories of symbols that have been produced in the project:

    0. Main choices and generic icons
    1. Calendar
    2. Preferences and personalisation
    3. Status and commands
    4. Tasks and activities
    5. Items
    6. Map and navigation
    7. Money handling and gaming

    The whole repository is available on the POSEIDON web on http://www.poseidon-project.org/product/symbols/:

[12] http://easy-to-read.eu/?page_id=8 and http://www.leichtesprache.org/ and Information for all European standards for making information easy to read and understand http://www.inspiredservices.org.uk/Information%20for%20all.pdf



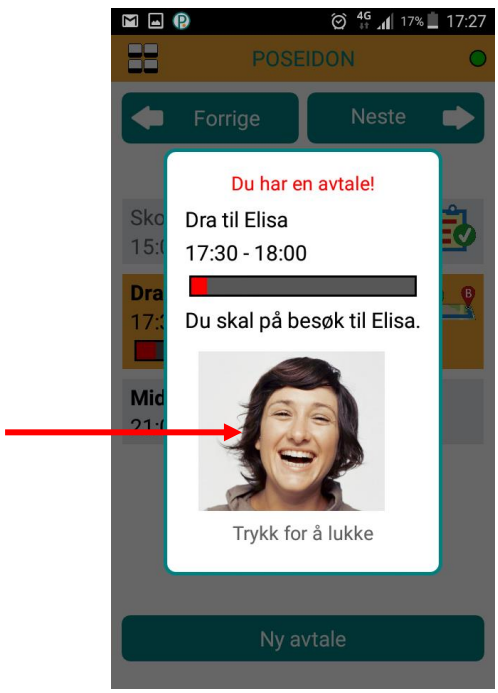
The symbols are visually clear and designed to create readable image also in small size, e.g. on a smartphone.

Example category: Tasks and activities

Each symbol can be expanded to full size, and they have a name:

dancing

3. In addition to the POSEIDON symbol repository, carers may **upload any picture material** that they have access to, e.g. on their own PCs, such as photographs or drawings. This is useful for example when a calendar event is about visiting a familiar person, or going to a place where visual recognition is helpful:



… or adding instruction list items to the event so that the end user recognises as her/his personal things to be taken along (e.g. when symbols are sufficient for recognition):

4. For end users who need an additional modality (in addition to text and symbols) in the calendar or navigation, application, carers can **record spoken messages or instructions**. This aspect of personalisation can compensate for the drawbacks of synthetic voice:

   - It is sometimes too fast.

- Sometimes synthetic voice reads in a "funny" way vis-a-vis the spelling, is and is then not understandable to the person with Down syndrome.
- The frequencies of it can be difficult, if the person has hearing difficulty.
- Synthetic voices are not always available; they have to be down-loaded.
- Synthetic voice applications may be too expensive for some families.

5. Yet another personalisation feature connected to the navigation app is the opportunity to **connect specific picture material and advice in the route** that is created step by step by the carer.

   For many persons with Down syndrome, conceptual and/or abstract information, such as maps and routes on maps, can be concretised and made highly personal according to their particular knowledge of the environment, and be concretised by providing route details that can be recalled by the end user in the real outdoors environment.

6. **Video material** is an example of advanced personalisable content that can be utilised to support the end user in different ways. Personal video clips can be added to the calendar similar to symbols, and also accessed through a list of videos[13]. For many persons with Down syndrome, carer-made video clips of procedural everyday activities may be to great support, especially according to possible *working memory difficulties and abstract information such as maps*. Example: Calendar tells to go to cinema. Video clip shows how to fetch the ticket from the ticket automate.

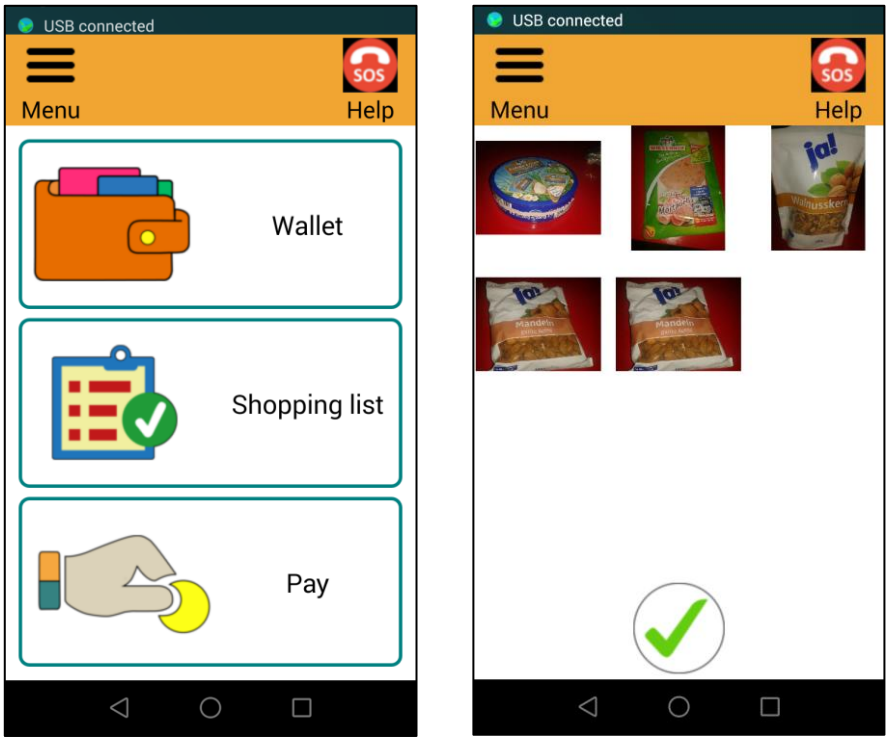
3.2 Other functionalities that support personalisation

7. It is possible to **define the timing of the reminding prompt** in the calendar. This is extremely important, because some cannot be reminded too long before an event/appointment, as they are fixed on the current task and are not able to do other things up to the event. Others need a reminder long time before, because it is necessary for them to know the exact plan, what is coming and when. These are opposite types of cognitive styles, but both exist.

8. The **list functionality** as such is an important functionality for personalisation. It can compensate for working memory difficulty and be used in several different situations, to include any items that support a particular end user (e.g. things to put in the school-bag, steps to take during the morning, shopping list[14], places to visit etc.).

[13] The list of videos will appear on the home page of the POSEIDON mobile application as one of the main choices (see Chapter 6).
[14] The shopping app will appear on the home page of the POSEIDON mobile application as one of the main choices (see Chapter 6).

The personalised shopping list with products and prices is a very important aspect of daily coping and independence, in addition to the calendar functionality and navigation outdoors:



The two main personalisation aspects offered by the shopping app are:

- The ability to input into the virtual wallet exactly the coins and bills used for shopping.
- The shopping list is highly personalised since one can input own images and specific prices of the product.
- The shopping app supports personalisation.

3.3 Application preferences

POSEIDON applications have settings and personal preferences to customise the application functionality. The POSEIDON development framework provides a central store for all such settings and preferences, for all POSEIDON applications. **This is part of the POSEIDON account, stored in the Smart-Platform part of the infrastructure**.

All applications do an authenticating transaction with the infrastructure, logging in as a POSEIDON user. They can then request the user profile of the POSEIDON account, where any number of preferences can be stored as key-value pairs. Applications can also update preference values, writing these back to the central store. New applications developed for POSEIDON should use this personal profile, and look at the preferences already defined, to reuse the relevant preferences and insure consistent personalisation across applications.

Some of the preference categories in use in the prototype system (see section 3.6 of this document, Support for personalisation in the Developer Framework):

- Tracking and calendar notification preferences are used by the mobile application.
- Web and mobile application have user interface preferences.
- The context awareness middleware and interactive table have their own preferences.

The web application for secondary end users (carers) is the main user interface for changing the preference values, allowing carers to manage preferences *remotely*, without needing to access the

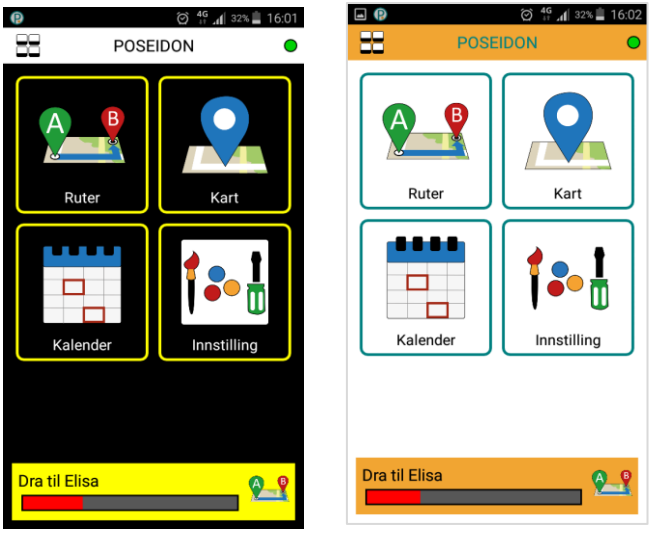
individual applications. Some preferences can also be changed locally, and some preferences should be directly controlled by the primary user (such as the privacy preference of whether to be tracked).

3.3.1 Preferences for mobile app

Here we describe the preferences of the POSEIDON mobile application prototype most relevant for personalisation. The app has other types of preferences as well. There is for example a setting for whether video streaming can use a mobile subscription or not, so that it can be limited to Wi-Fi to save on data cost. This is an example of a more technical setting.

3.3.1.1 Colour schema

POSEIDON palette or high-contrast palette: The POSEIDON application on smartphones offers two different colour schemas. Both are visually clear, but the high-contrast option may suit better for end users with visual impairment. This implementation is according to the advice from Maggie Wood-house[15] from the Advisory Committee of POSEIDON, at a consortium meeting in London with main focus on vision impairments of people with Down syndrome.

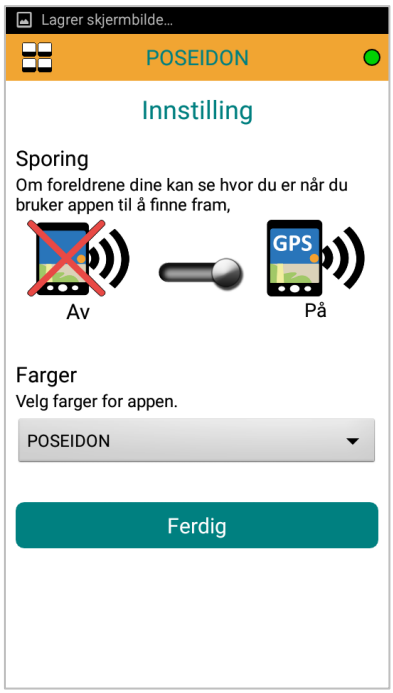


3.3.1.2 Position tracking

In the POSEIDON mobile application, the primary user can choose to **switch the tracking feature (GPS) on or off**. When off, the application only uses GPS when doing navigation, and the position information is not sent to the POSEIDON infrastructure where it would be available to authorised users. When on, the application sends the position data to the infrastructure, and also positions the user at regular intervals when not in navigation. The position data is available in the web application, so that carers can monitor their users.

The preference setting is included in the POSEIDON end user's app, based on the project teams and Down syndrome expert's discussions we had with the primary, secondary and tertiary users at the second seminar in Mainz. It was explicitly stated that a balance between security and privacy should be enabled: For some end users this may be a feature too demanding to comprehend or use, whilst others may well be able to utilise this option. An example of use is when adult end users do not want to be tracked by carers or helpers, and when they have the authorisation/competency to make this decision.

[15] http://www.cardiff.ac.uk/research/downs-syndrome-vision-research-unit



How often to get a 'GPS position fix' when tracking is enabled, is also a preference. This more technical setting is mainly to balance battery usage (getting a GPS position fix consumes some battery) with the need for accurate monitoring, and is set by the secondary user in the web application.

3.3.1.3 Calendar notification

How the application notifies the user of calendar events is a mix between how the event is defined and the application preferences for notification. The event itself may have reminders ahead of time. The application will always provide notifications at the reminder times. In addition, it can provide notifications at the start time of all events, regardless of whether they have reminders or not. Whether to provide start time notifications or not is a personal preference.

Notifications use the notification system of the phone, placing a notification in the notification bar and playing sound and vibration. Such notifications can be insistent or not. If insistent, the sound and vibration is constantly repeated until the notification is acknowledged. Otherwise, it typically only plays once (the details are phone-dependent). Whether notifications are insistent or not is a personal preference.

If a calendar event has a route for navigation, the context middleware will be used to provide a weather-based message to the user, to remind them to wear appropriate clothes. There is only a message if the weather is categorised as needing attention, such as hot, cold or rainy. The message text itself can be specified as part of the user profile (entered through the POSEIDON web application), with default messages if a personalised one is not provided.

Preferences for context awareness are listed at the end of the next chapter.

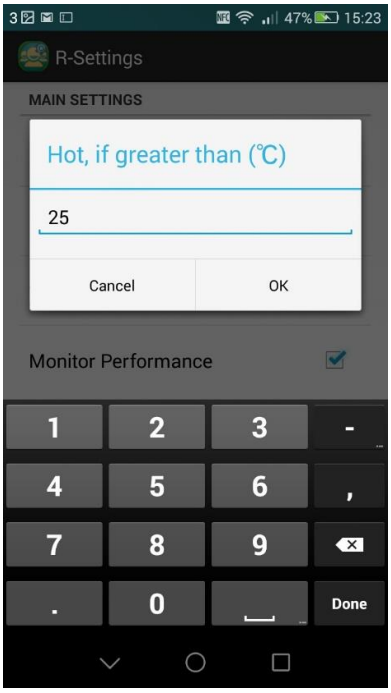
3.4 Context awareness in POSEIDON as part of personalisation

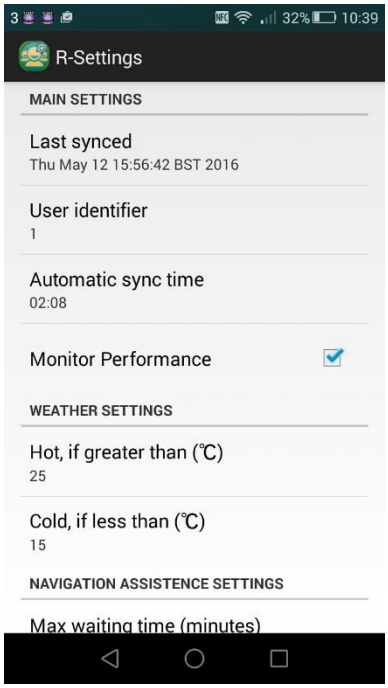
Using context awareness, the POSEIDON applications can adapt, and inform the user based on context of the user, device, and environment. These contexts rely on rules created by developers, which can control what the system will describe certain situations, for example if it is considered cold outside.

By being context-aware, an app can dynamically change either the content, or the behaviour of the application to suit a given situation. We gather the different situational data from different sources including phone sensors, internet resources, and behaviours of the primary end users. This includes

information about light levels, location, facing direction, weather forecasts, perhaps traffic one day (providing sources exist).

The data is put into a knowledge conceptualisation repository. Two main effects can be gained this way: (a) Reactiveness: Dealing with for example the user deviating for a route, or possibly waiting for a bus that does not arrive. (b) Proactiveness: Dealing with weather conditions are different locations, possibly looking at traffic conditions ahead of time before a journey commences. Other apps in the market are more static.





In traditional context-aware systems, rules and parameters are often static, and unknown to the user. Users though may experience or require differences in these rules, to better suit their personality, locality, medical conditions etc. Just like other parts of the POSEIDON, the context awareness should allow for personalisation, where possible. In the Context Reasoning Middleware, we allow for personalisation of different contextual parameters. For example, with the weather context, different users including those with fair skin could be more sensitive to hot weather. The secondary user can also set parameters to state the longest amount of time the primary user can be waiting at the bus stop e.g. This value can be changed depending on the seasons, as in winter it is not a good idea to wait too long outside. These personalisation options give greater control to the users to help tailor the context rules to their needs.

Currently, the POSEIDON system supports personalisation for the following contexts:

- **Weather**: User can set their rated hot and cold temperatures. We verify that hot temperature is always above the cold temperature.
- **Standstill**: User can set the maximum amount of time they can be relatively standstill. This is useful for when the user waits for the bus.
- **Deviations**: User can set the maximum number of small deviations in a route, before the user is offered assistance by the secondary user.

Other personalisable elements in the context reasoner include the ability of the user to select whether the data from the mobile device can be used by the learning and reasoning module, currently accessible on the POSEIDON Carers web. As the reasoner needs to occasionally synchronise its data with the

POSEIDON services, the user can set an appropriate time in which to do this e.g when at home, and the phone is on charge.

When the context personalisations are altered, they are then set for the next time the context is needed by the system. In the event that the context affected is currently running, the context is restarted with the new preference.

Personalisation while giving users greater control, do present a verification issue regarding contexts. For example, the user could set the cold temperature less than the hot temperature. This confuses the semantics of the rules. Research is currently ongoing to consider a general purpose approach to verification, and context language extensions to support this.

Below, we show a short extract of the reasoner solution's text table which represent communication vis-à-vis carers. The personalisation features of context awareness are available in the POSEIDON personalisation web[16].

Weather settings	**Title for weather related settings**	**Innstillinger for været**	**Wettereinstellungen**
Hot, if greater than (C)	The temperature is considered hot, if the temperature is greater than the ...stated degrees	Varmere enn (C)	Warm, wenn die Temperatur höher ist als (°C)
Cold, if less than (C)	The temperature is considered cold, if the temperature is less than the stated degrees	Kaldere enn (C)	Kalt, wenn die Temperatur niedriger ist als (°C)
Specified hot temperature must be greater than cold	The hot temperature number entered must be greater than what is set for cold	Innstillingen for varmt må være høyere enn for kaldt	Die angegebene warme Temperatur muss höher sein als die kalte Temperatur.
Specified cold temperature must be less than hot	The cold temperature number entered must be less than what is set for hot	Innstillingen for kaldt må være lavere enn for varmt	Die angegebene kalte Temperatur muss niedriger sein als die warme Temperatur.
Navigation assistance settings	**Title for settings regarding navigation assistance settings**	**Innstillinger for navigeringshjelp**	**Einstellungen für Navigationshilfe**
Max waiting time (minutes)	The maximum time the user can be standing still for, in minutes	Lengst ventetid (minutter)	Maximale Wartezeit (in Minuten)
Max number of small route mistakes	The maximum number of times a user can make small deviations	Tillatt antall ganger for små avvik fra ruter	Maximale Anzahl an kleinen Abweichungen von der Route

3.5 Personalisation on the POSEIDON web

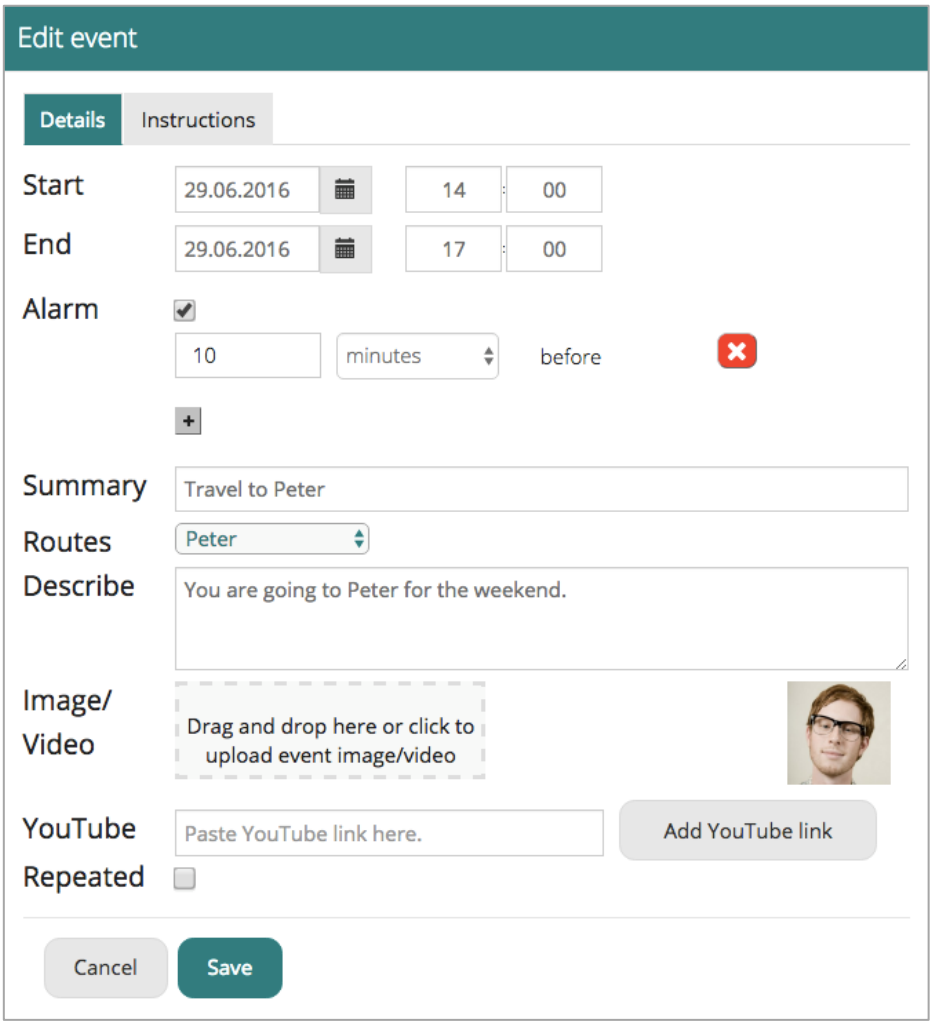
The POSEIDON web has been designed to accommodate the personalisation of primary end user's applications. On this website, the carer may adjust a number of features to fit the end user's individual requirements (vis-à-vis abilities) and preferences (even "likes or dislikes"). It provides customised

[16] The source code of the reasoner is Open Source, and documented as such. Additional documentation of the ontology and user modelling can be found in Deliverable D3.1, whilst the Open Source and reasoning engine is documentation is available in Deliverables D3.2, D5.1 and D5.4.

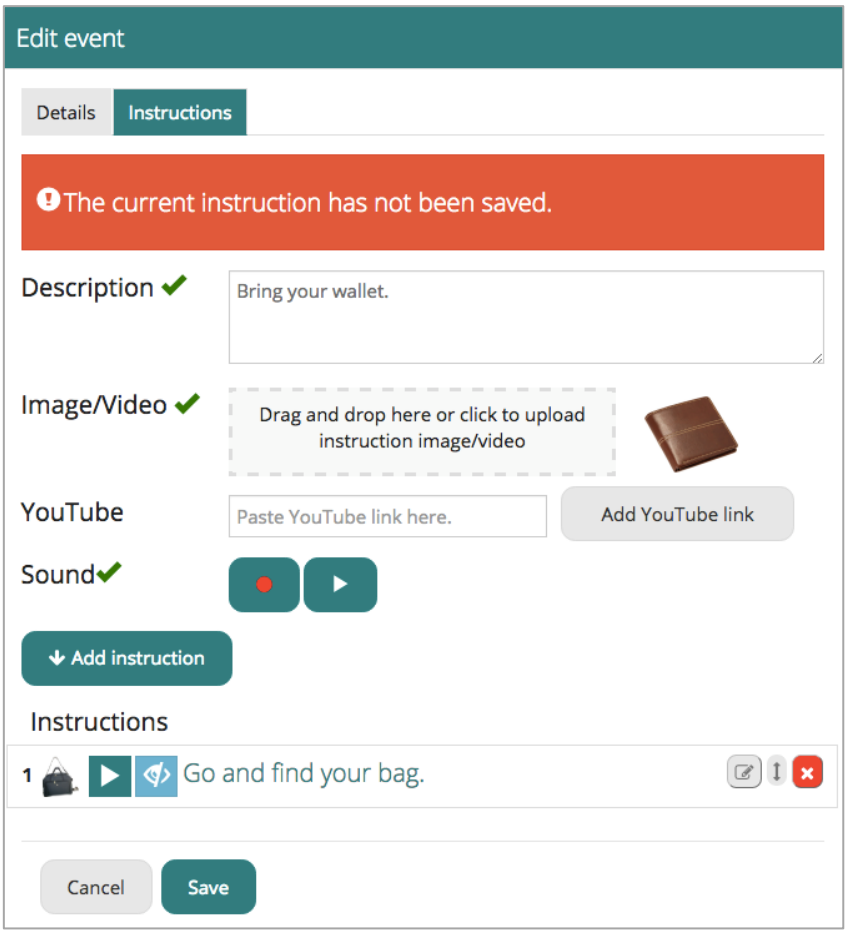
calendar events, a shopping list, monitoring of the primary end user, video management, and a set-up functionality for the POSEIDON app and the context awareness.

Calendar

- Event: An event on the POSEIDON web is a customised remainder that is pushed to the end user application in order to ease the escort of the carers. In addition to normal event properties like starting/finishing time, description, summary, alarms, repeating rules. The POSEIDON calendar event also provides a multimedia description of the event, such as image/video and routes of the event if the event contains an outdoor trip. The video functionality supports both uploading videos directly or providing a YouTube-link.



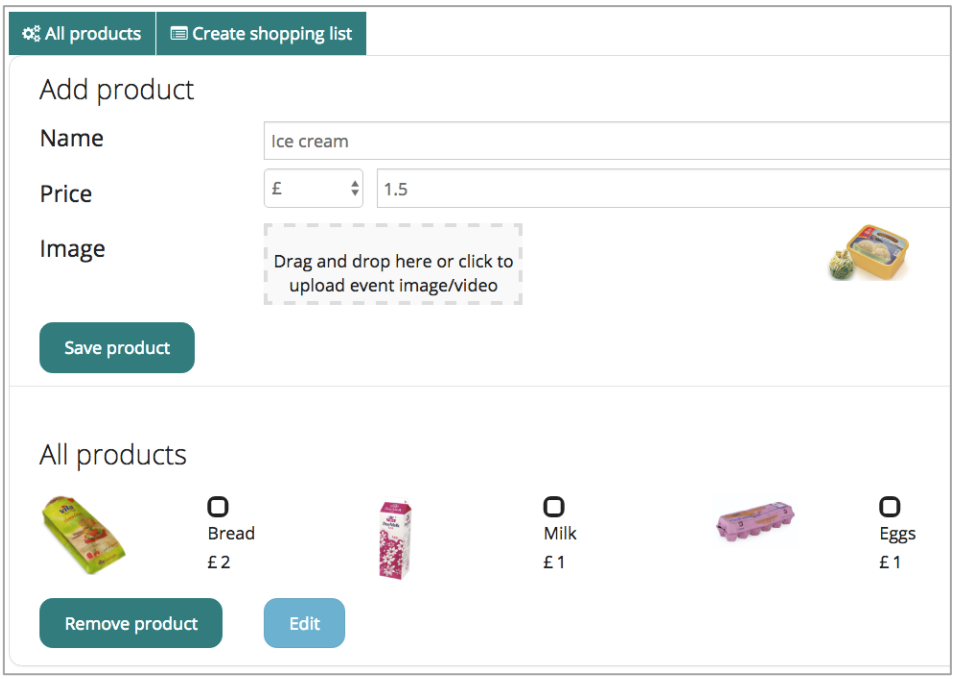
- Event instructions: An event may contain several steps or activities. The instructions of these activities can be provided through a text description, an image, audio speech, or videos. Videos can be either uploaded to the POSEIDON file server or provided through a YouTube-link.

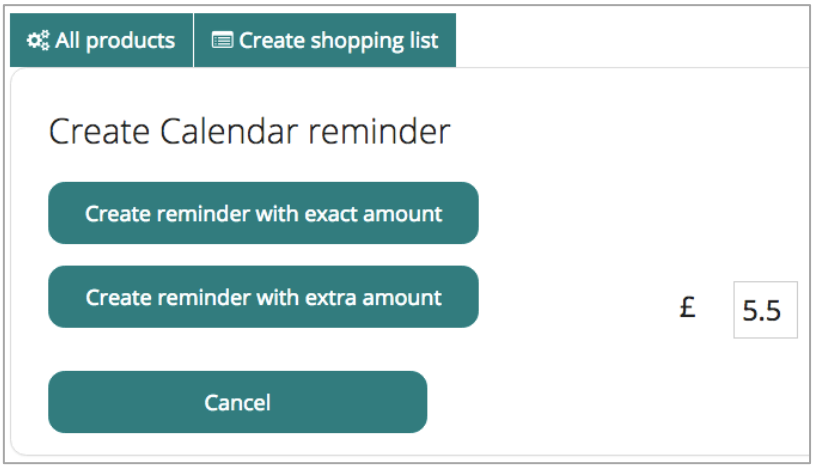


The POSEIDON calendar will push the events to the POSEIDON app which is then used by the primary end user.

Shopping

- The shopping component is personalised to the shopping needs of the primary end user. The carers can here conduct the necessary pre-work to upload product images, prices and quantities, and to store the information in the POSEIDON system. A training app has been developed and it can transport the information to the primary end user's app to accommodate his/her autonomous shopping activities.

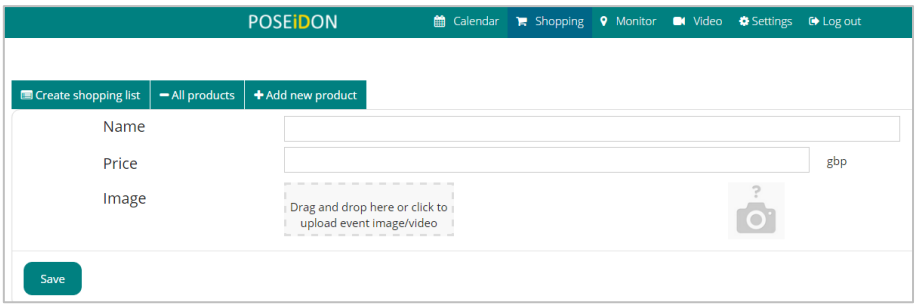




- Shopping list with a number of products including prices: The shopping component can create a shopping list, and after the creation of the shopping list, a calendar event can be added and further edited on the calendar component.

Video list

- Video: the video list supports user to upload videos both from local PC or from a YouTube-link to provide support or escort to the primary user.



- Settings: In the component for settings, the user can set several personalisation issues: (a) personalise the mobile theme by choosing among the colour palette of the application (currently, the POSEIDON palette and high contrast palette are provided), (b) configure the POSEIDON web theme (currently, the POSEIDON theme and a light green theme are provided), (c) learning and reasoning, (d) specify weather notification messages. The personalisation of the application can also be performed here, e.g., to allow data-streaming on mobile network or not, or to provide a notification when an event starts in the primary end user's app.

  For learning and reasoning, the POSEIDON web provides personalisation for context awareness monitoring, and provides analysis of gathered data. For example, for the historical activity the primary user carried out, it can be concluded which route was carried out most successfully. The carer can select a series of properties for the learning module, e.g., select a time interval, and select a route to show how much time the primary user has spent on that particular activity.

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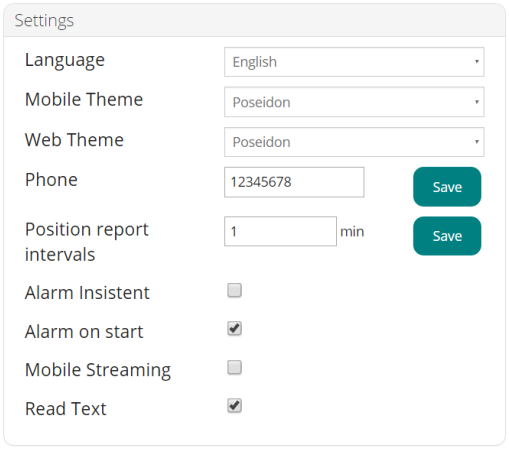
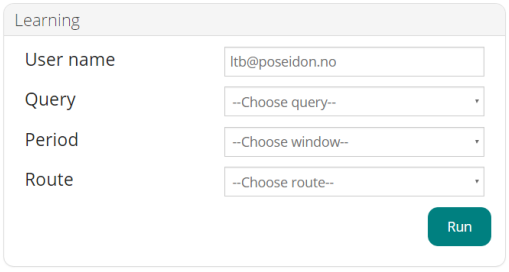
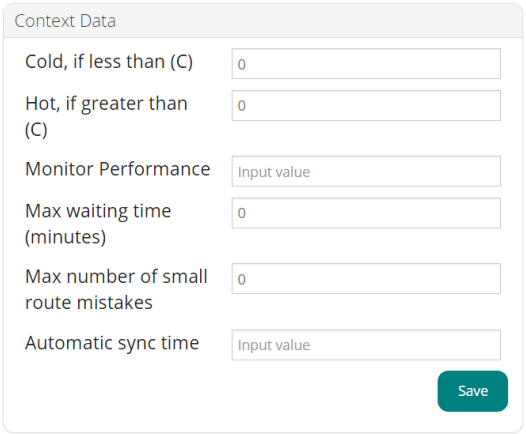






3.6 Support for personalisation in the Developer Framework

This section is copied in an excerpt of D5.1 Developer framework, section 4.4 Personalisation support and give guidance for how personalisation can be implemented by use of the POSEIDON Developer framework.
(Ref: http://www.poseidon-project.org/wp-content/uploads/D5.1-Development-framework-v4.pdf).

Individual personalisation of services is always important in the assisted living domain, to make sure each user gets the appropriate functionality and content. It is especially important for people with Down syndrome, as there are big differences between individual capabilities and needs. The framework needs to support personalisation. Personalisation is an aspect needed in most components of the system. Here we give an overview of the main personalisation mechanisms currently provided by the infrastructure and used in the pilot applications. This support is two-fold: providing a shared store of personal preferences for applications, and providing shared storage and standards for content. The infrastructure is described in more detail in the next chapter. Keep in mind that the infrastructure is there to enable application development – it is up to the applications to use these mechanisms and others to provide a personalised service to the end users.

3.6.1 Preferences

The POSEIDON account, stored on the SmartPlatform service, includes a user profile which can store any number of preferences as key-value pairs. All POSEIDON applications should connect to the SmartPlatform service, logging in to the account and retrieving this user profile. Preferences for the user and the applications should be stored here. This common store of preferences allows them to be reused between applications, as illustrated in the figure below. The preferences are retrieved and updated through the SmartPlatform API. The technical details of this API are given in deliverable D5.4, chapter 2. See section 2.5 for the relevant information and example code. (Ref: http://www.poseidon-project.org/wp-content/uploads/D5.4-Databases-for-integration-of-services-v4.pdf).

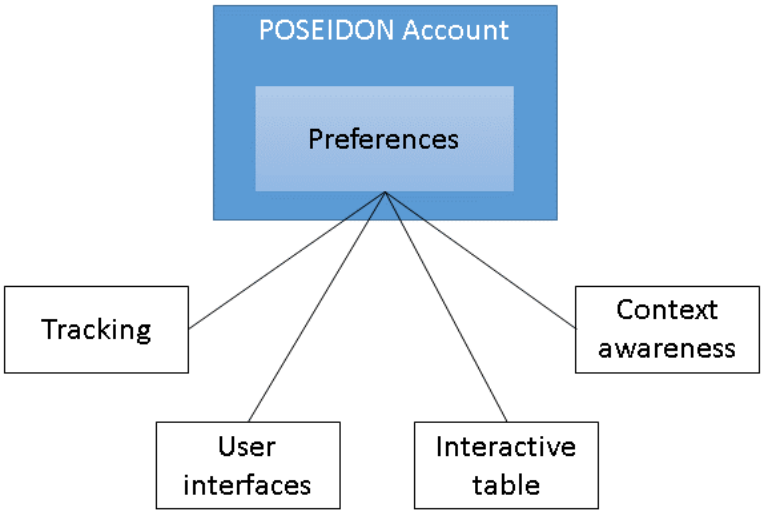


Figure: Preferences used by multiple applications

In the prototype system, most of the preferences can be edited in the web application. Examples of preferences used by prototype applications are visual theme for primary user interfaces, and whether or not the position of the primary user is tracked (the last one is not available in the web interface, as this web is mainly for secondary users while the primary users should have full control of this preference). Section 2.5 of D5.4 has a list of preferences and other properties currently used, which may be of interest to multiple applications. So far, the approach has been for applications to check if there are any existing preferences they can reuse, otherwise add new preferences as needed. With more maturity and applications, it will be possible to define a bigger set of standard, general preferences.

3.6.2 Content

Feil! Fant ikke referansekilden. figure below shows an overview of the personal content supported by the infrastructure for the pilot applications. Storage is provided by two services, the file server and calendar service. Each of these has a well-defined API for applications to use to upload and retrieve content, and well-defined data formats. These are described in more detail in the next chapter, and the technical specifications for developers are given in deliverable D5.4. Here we give an overview of the data, with a focus on personalisation.

Three forms of instructional content is created by secondary users and stored on the file server:

- Routes: Routes for navigation training and real-time navigation. The route format is based on that used by Google, but with the addition of custom text, images and recorded sound for each instruction step. In the prototype 2 system, routes were generated by Google's service and then personalised by the secondary user. Now the route is fully personalised, with the secondary user defining the route geometry as well.
- Shopping lists: Products are registered with prices and images, and then used to create shopping lists for money training and shopping assistance. This is all defined by the secondary users.
- Video list: A personal list of videos, intended for instructional videos, can be defined.

Note that the filer server provides general purpose storage of files, and so can be used to store other content, but those described here are the data formats defined by the framework to insure the necessary functionality for the prototypes and interoperability between applications.

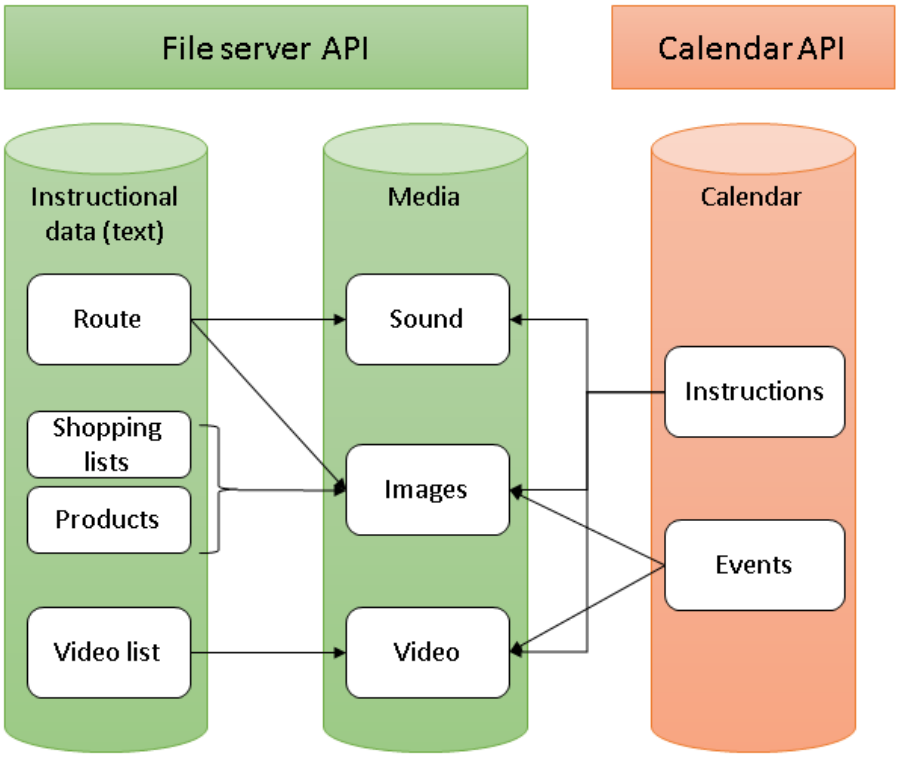


Figure: Personal content in the infrastructure

On the calendar side, content is organised as events in a time schedule. This is based on the normal calendar event model, with such fields as title, description and alert time, but support for images and video is added for further personalisation. In addition, a list of instructions can be added to any event, and each instruction can have text, image, sound and/or video. Personalisation of how the user is notified of events is a combination of account preferences and event content. Notification times can

be defined for the individual event, to make sure the user is notified a specific amount of time ahead of the event. Preferences control how the calendar application notifies the user. Currently, two preferences are used. One preference specifies if the user should be notified at the start time of the event, which then happens for all events, in addition to any notifications before the start time specified by the event. The other preference is whether the notification (sound and vibration) should be continuous until acknowledged or less insistent.

The figure also shows which forms of media can be included in which content items. Media are files stored on the file server.

3.6.3 Other mechanisms

There will in some cases be personalization mechanisms outside the infrastructure. One example is the configuration of Android devices. The Android system, used on mobile devices for the prototypes, has a large number of settings which affect the applications running on the device. The user interacts with these settings through the Settings application of the device. Depending on the setting, it is either not possible or very bad practice for an application to change such settings directly. The user should be in control, through the Settings interface of the device.

One example of a relevant setting is font size. POSEIDON users may want to tweak this based on their eyesight. The font size in user interfaces made on Android's API can either be controlled by the global device setting, or not at all. It is not possible for a single application to change the font size only for itself, and the user should make the change through the user interface provided by the device. This is disruptive with respect to providing a complete and user-friendly service to people with special needs, but it is the price we pay to use generic devices.

4 Personalisation best practice from POSEIDON

For the final development of POSEIDON, the following personalisation features have been evaluated by DSAs in all participating countries during the last half year of the project.

1. **Turning speech on/off – recorded messages or synthetic speech**. For persons with Down syndrome with low reading ability and/or some degree of visual impairment, spoken messages may indeed be of superior help, and also reassuring if these are recorded by carer(s) and thus play back a familiar, natural voice. In certain situations, this may be disturbing or even embarrassing, and it should be an option for the end user herself/himself to decide if s/he wants to enable/disable the speech. In other situations, it may be desirable to run on the speech, e.g. for safety in a navigation situation in order to look at the traffic instead of the screen. (Use of ear-phones will not be an option for all end users as they may prohibit the end user from hearing vital sounds from the environment, e.g. in traffic.)

   The design of this feature will be similar as the current navigation app's tracking choice:

   By whom: carer and end user

2. **Synthetic speech:** In order to provide the opportunity to listen to all texts in the apps, synthetic speech will be integrated with the apps. Suitable software packages are many[17]. Currently, synthetic speech is readily available in some smartphones and further development here may

[17] http://elearningindustry.com/top-10-text-to-speech-tts-software-elearning

make use of separate software excessive. For the web applications in browsers on PCs, such software will probably be necessary.

By whom: carer and end user

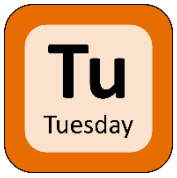
3. Depending on the reading ability and experienced educational approach, **different text alternatives** as combinations of capital letters and dashed words:

beautiful	BEAUTIFUL
beau-ti-ful	BEAU-TI-FUL

NB. Enlargement of text (T → T) directly on the screen of the device is embedded in the smartphone's user interface, and is therefore defaulted as a sufficient solution.

By whom: carer

4. **Text-free apps**: Some persons with Down syndrome cannot read. For them a text free version of POSEIDON will be provided (some symbols may be character-based such as weekdays or monetary units), and it can be optional to choose descriptive text to a symbol/icon.



This option will require that the carers populate the apps with personalising symbols for example in the calendar and the check-lists, in addition to the "hard-wired" symbols in the apps. The POSEIDON symbol repository offers here a large number of suitable building blocks.

By whom: carer

5. **"Persuasive gaming" levels** may include two approaches to motivate the end user to play and learn more in the POSEIDON Home Navigation Training app: indicating the time left and rewarding the result (e.g. a voice saying "Congratulations, you managed it!" or an animation of heart/fireworks on the screen, or both). Children/persons with Down syndrome may love to do tasks in a simplified way in a game as they often love television and computer games. This may increase the interest for this training task. Adequate personalisation will lead to more play and better navigation capabilities with the navigation app. Examples are "players" who enjoy the reward, but who cannot tackle the stress created by the clock ticking or who cannot read a clock (c), or a person who enjoys both (a).

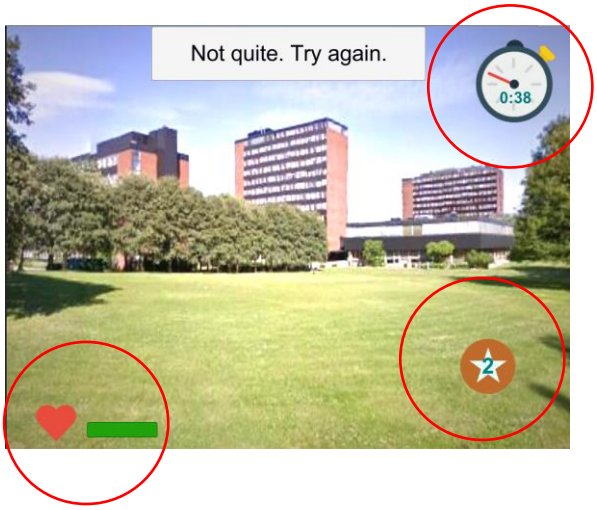
Clock on	a	b
Clock off	c	d
	Rewarding feature on	Rewarding feature off

For additional personalisation, different types of clocks can be offered to the end user who cannot read a digital clock. Examples are the ones that have been developed by the Italian Down syndrome association. These were presented at the first POSEIDON seminar in Oslo by Anna Contardi[18]:

[18] Anna Contardi is a member of the POSEIDON Advisory Committee and Manager of the Italian Down syndrome association and general secretary of EDSA (European Down Syndrome Association).

By whom: carer

In the pictures below, possible gamification aspects are shown (POSEIDON Home Navigation Training app):

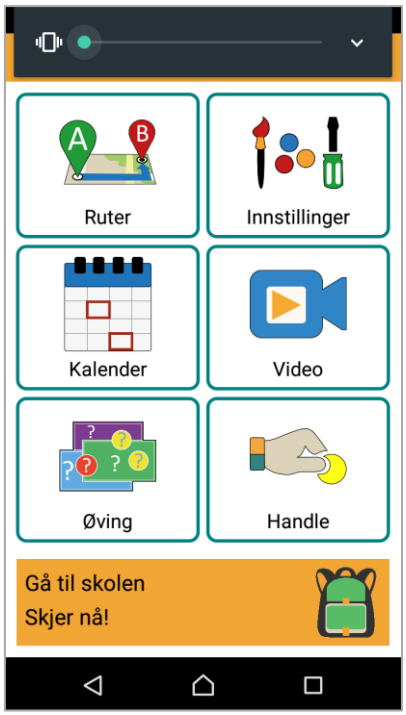


6. **POSEIDON apps on/off**: An opportunity to choose among useful apps will be implemented. This personalisation option will simplify the user interface for those end users who cannot make use of all POSEIDON apps.

   By whom: carer

7. **The POSEIDON symbol repository** will be extended according to end user needs exposed in the remaining user-centric activities. All symbols will also be presented in a downloadable catalogue for overview.

8. The POSEIDON mobile app's home has been extended with **new choices** with highly personalisable functionality: the shopping list, money handling exercise, and the video library. What are the most suitable functions to be shown on the home page *is still under evaluation (Pilot 2)*.


Ruter
Innstillinger
Kalender
Video
Øving
Handle
Gå til skolen
Skjer nå!