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UI Prototypes

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5	29.07.2013	Assigned given requirements to categories. Labeled each requirement.
6	05.08.2013	Revised summary and conclusion.
7	22.08.2013	Comments from internal review were incorporated.

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Executive Summary

In this document we summarize the insights of conducted user studies to a set of concrete requirements. Based on this requirements we design and present an overall interaction concept for the NavMem prototype. Each of the identified main functionalities is illustrated in a separate section, whereby potential interaction flows and design ideas are presented. This document will inspire future design and development processes and will provide a valuable resource for the planning and conducting of evaluations.

1 Introduction

In the NavMem project we follow the Human-Centred Design (HCD, ISO 9241-210) process. Initially, we conducted several user studies and reported our findings in Deliverable D1.1 ("User & Context Requirements"). In this deliverable we continue in the HCD process and specify a first prototype of the overall user interface.

We start with a brief summary of the identified requirements and user needs. As extension to earlier deliverables we group the requirements into sections and identified a set of functional and non-functional requirements. Thereby, we create a foundation for the following design processes and later evaluations.

The main contribution of this deliverable is a holistic prototype of the user interface. This deliverable presents an overview of the overall prototype functionality. Further, feature-specific subcategories are identified, which are elaborated on in more detail. These subcategories will be subject to further research and later in-depth evaluations.

2 Summary of Requirements

The initial user investigations presented in D1.1 provide background information for the current document. For details we refer the reader to D1.1, but in the following we summarize the results from the initial user studies.

2.1 Use Case-specific Requirements

Identifier	Requirement	User groups[1]
UC1	The system should support an active lifestyle	D
UC2	The system should support in doing daily activities outside	D
UC3	The system should support in doing social activities (e.g. visit to friends/family)	D

[1] User groups: (D)ementia, (E)lderly, (S)troke

2.2 Navigation and Orientation

Identifier	Requirement	User groups
NO1	Clear information on directions and avoid coded information or mental rotations	S
NO2	The system should provide support in case of disorientation	D
NO3	Important not to get lost	E
NO4	The system should provide accessible routing	S
NO5	The system should only provide navigation support when needed	D
NO6	The system should automatically recognize a disorientation event	D
NO7	The system might provide navigation support inside	D

2.3 Lifeline

Identifier	Requirement	User groups
LL1	The device should also be used by bystanders to call for help when necessary	D
LL2	The system should provide a lifeline	S
LL3	The system could monitor the activities performed by the user	D
LL4	The system should facilitate help provided by (a informal) caregiver automatically when needed	D
LL5	The user can contact an informal caregiver in times of need	D
LL6	The (informal) carer could also contact the user (two-way communication)	D
LL7	The system must contain “tracking at a distance”	D
LL8	One can decide who should be called and who should be able to determine the whereabouts	E

2.4 Information Presentation

Identifier	Requirement	User groups
IP1	The interface could include information about the surroundings to support memory	D
IP2	Provide current location in the interface	E
IP3	The system should provide simple memory aid	S
IP4	The system should allow both for simple and more advanced information	S
IP5	Limit the amount of information	S

IP6	Provide appropriate reminders	S
IP7	Information available multimodally	S
IP8	Clear and easy to understand information	E
IP9	Program and command naming should be carefully considered and in accordance with the users' mental models	E
IP10	Provide clear confirmation of target capture (i.e. button press, visited link). The user should not be expected to detect small changes	E
IP11	Avoid pull down menus	E
IP12	Information should be concentrated mainly in the centre	E
IP13	Provide ample time to read information	E
IP14	Error message should be simple and easy to follow	E
IP15	Avoid moving text	E
IP16	Avoid fancy font types	E
IP17	Keep texts short	S
IP18	Provide the possibility to zoom in on small text	E
IP19	Minimize numbers of steps	S
IP20	Clear navigation should be provided	E
IP21	Clearly show which tasks are active	E
IP22	Do not have very deep hierarchy and group information into meaningful categories	E
IP23	Reduce the demand on working memory by supporting recognition rather than recall and provide fewer choice to the user	E
IP24	Main navigation always the same and critical functions should not disappear	E
IP25	Important features should be available directly via a labeled button and not via menu navigation	E
IP26	A single, consistently placed button for returning to the home state should be included	E
IP27	Colours should be used conservatively	E
IP28	Background screens should not be pure white or change rapidly in brightness between screens. Also, a high contrast between the foreground should exist.	E
IP29	Icons should be simple and meaningful and also labeled (with a large enough font)	E
IP30	Consider using images	S
IP31	Important information should be highlighted	E
IP32	Graphics should be relevant and not for decoration.	E
IP33	Images should have alt tags	E

IP34	An online help should be provided	E

2.5 Physical Requirements and Ergonomics

Identifier	Requirement	User groups
PE1	The device needs to be robust and reliable	E
PE2	If a special device, small, light and long power supply	E
PE3	The system should contain a GSM unit in order to call for help in an emergency	E
PE4	Possible to manipulate with one hand only	S
PE5	Keys and screen needs to be large enough	E
PE6	Display has to be readable under all lighting conditions	E
PE7	Mobile devices should have a wide range of volume levels	E
PE8	Provide large, clear and bright screens	E
PE9	Provide large buttons	E
PE10	Eliminate buttons on the sides and rear of devices	E

2.6 Non-functional Requirements/Appearance

Identifier	Requirement	User groups
AC1	The system should support the user in navigation and orientation in an unobtrusive manner	D
AC2	The system should be easy to use	D, E
AC3	The system should be easy to learn	D
AC4	The system should be reliable	D
AC5	Safe and secure	S
AC6	Flexible and adaptable	S
AC7	Easy to manipulate	S
AC8	Easy to bring	S
AC9	Easy to remember	S
AC10	The interface should be very simple	D

2.7 Compatibility with Tools and Infrastructure

Identifier	Requirement	User groups
CO1	The system should also be suitable for wheelchair use	D
CO2	The system could be compatible with other memory aid systems (e.g. digital calendar)	D
CO3	Mobile devices should be compatible with hearing aids	E

2.8 Input Interactions

Identifier	Requirement	User groups
II1	Several input modalities should be included (audio hints can help for reduced vision)	E
II2	Slide-out keyboards should be avoided	E
II3	Older users should not be expected to double click because of slower hand movements	E
II4	Tapping often preferred to drag and drop	E

2.9 Summary

The device/application to be developed should be easy to use – but also safe to use (it is important the user does not get suddenly stranded or led into areas not suited for walking). The designs need to take different sensory abilities into account – the user may have limited eyesight or have hearing problems. A specific requirement from the stroke investigations is that the device should be possible to manipulate with one hand only.

Although “Simple and easy to use” comes out as an overall requirement, what an individual user finds simple/ easy varies greatly, and the continued development within the project needs to iteratively test designs with target users. Another consideration that needs to be taken into account is that it is useful if both simple and more complex alternatives exists - although the more advanced functionality should be designed in such a way as not to clutter the interface & confuse users who want the simple alternative (one possibility is to have “simple mode” and “advanced mode” with simple mode as the default).

In general the requirements for the different groups are well aligned – easy to use (big buttons, multimodal presentation, no menus etc), simple, reliable and secure appear in all the lists. Specific for dementia is the larger focus on tracking and monitoring while the stroke group has the one handed use as a specific requirement. Differences, in the lists is in some part due to method differences and we suggest the overall requirements for elderly users are taken as a starting point, but that the development focuses on the specific needs of the users with dementia and stroke.

3 Envisioned Functionality of the Take Me Home Application

The user studies showed the need also for a very simple application, and the base line application for this is the “Take Me Home” application which prevents the user from getting lost, by always providing help on how to find the way back home.

This very simple application has one location, the home. This location can be specified by a helper or by the user himself/herself. The basic design is that the user activates the guidance by pressing a button ("Take me home") and then gets guidance through images, sound and vibration towards the home location. A clear notification is received once the home is reached. This application also includes a "call for help" function – and should warn the user if location or direction information becomes too unreliable or if there is a risk the battery power is running out. These additional functions are described in more detail in the following section (section 4.6, 4.7 and 4.8).

The basic functionality in this application is showed in Figure 1.

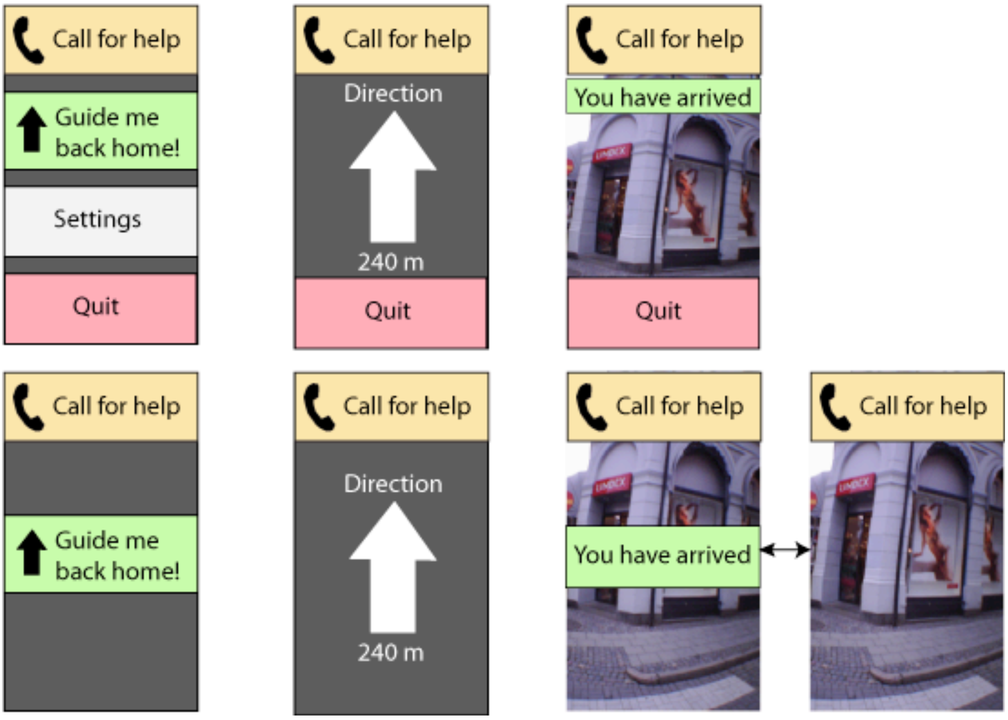


Figure 1: Basic "Take me home" functionality.

The top row in Figure 1 shows a "self contained" application where all functions in the application are reached though buttons in the interface. The second row shows a version where the operating system environment takes care of quit and settings functionality. During guidance feedback can also be experienced through speech and/or vibrations. Speech feedback can inform the user about changes of direction (turns etc), but should also provide updates regularly on if the user is walking in the right direction or not. Vibration feedback is given to enhance the directional information when the phone is pointing in the right direction or the user is walking in the right direction. This has been shown to be effective in previous work.

A clear notification is given once the user reaches the home location. The information can be given multimodally – both with text and possibly an image, speech and a vibration notification.

The final images in the top and bottom row illustrate how different presentation solutions could look like. We will investigate solutions that provide all the information at the same time, and solutions where we use (slow) animations to reduce the amount of information received simultaneously. Another question that will be explored is if there is a need for routing, or if this basic application can work also with direction “as the crow flies” which makes it possible to use also without a network connection (routing is typically done on a server). Nevertheless, the users safety will always remain top priority.

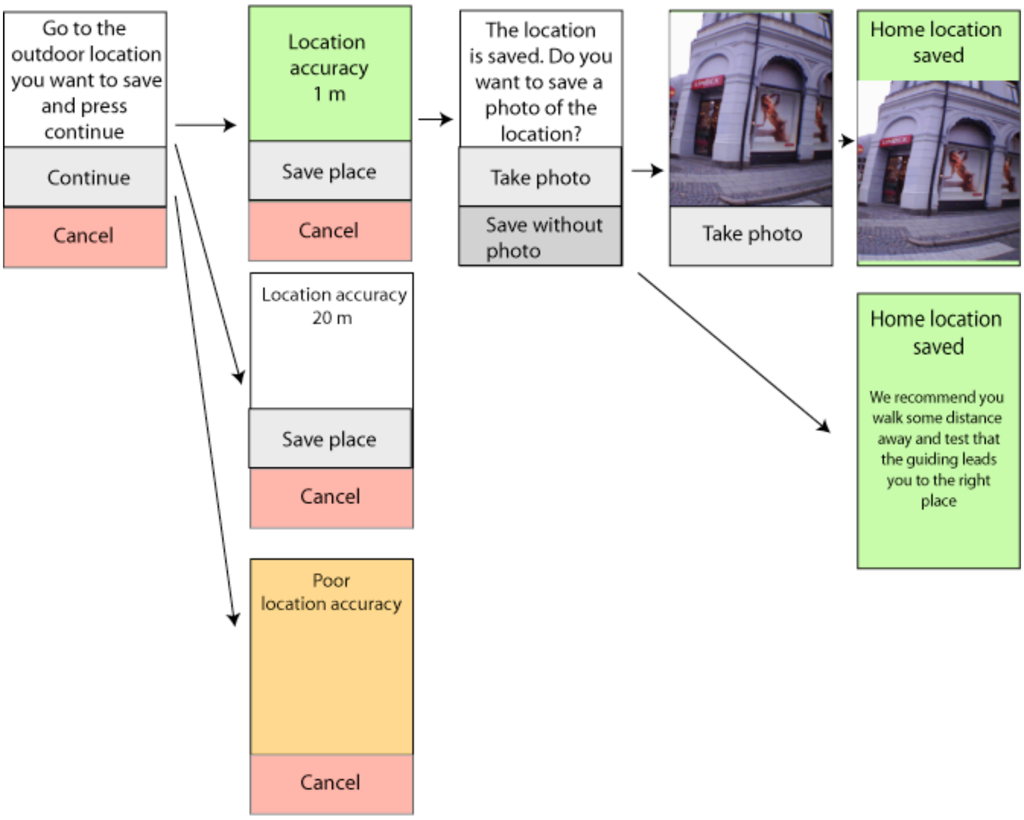


Figure 2: Application flow for specifying a home location.

The user gets instructions to go outdoors. There will be an animation/a delay to make sure the user waits long enough before saving the location – and the application also provides feedback on position accuracy. There is the possibility to add a photo of the home location. This may not be needed once the user is in a well known environment, but may be useful if the “home location” is new (eg. a hotel or a new flat).

We will include advice to the user to test that the location is correct by walking some distance away and try out the guiding to verify the home location was saved correctly.

The “Take Me Home” application will be developed so that it can be used both as a standalone application and as a function in the full navigational application described in the following section.

4 Envisioned Functionality of the Full Navigational Application

The full navigation application addresses all identified use case-specific requirements (UC1–UC3). The system supports and goes well along an active lifestyle (UC1) with many daily outdoor activities (UC2), like shopping. Social contacts are an essential element of the application, which supports the user in doing social activities (UC3).

The foreseen navigation and orientation concepts avoid coded information and support the natural way of thinking (NO1). The back end will consider the users individual needs and will allow accessible routing (NO4). The system monitors the user's orientation level in the background and automatically adapts to avoid getting lost (NO2, NO3, NO5, NO6). Indoor navigation will be integrated if reliable and safety-uncritical indoor navigation solutions exist (NO7, AC4, AC5).

The lifeline functionality allows a user to get in touch with caregivers and relatives easily (LL2). Any relative can at any time phone the user if needed (LL6). During communication, additional contextual information is shared (e.g., LL7, LL8). The lifeline functionality will be intuitive and can be operated by bystanders (LL1).

The user interface is minimalistic regarding navigation steps, and textual information (e.g., IP17, IP19, IP20). Clear and easy to follow instructions and information are presented (e.g., IP8, IP14). Graphics and icons are used whenever possible and helpful (e.g., IP7, IP30, IP31, IP32). The whole interface is optimized to support the memory (IP1), e.g., by providing the current location (IP2).

An overview of the envisioned functionality of the full navigational application, their individual components, and the interplay between these can be found in Figure 3.

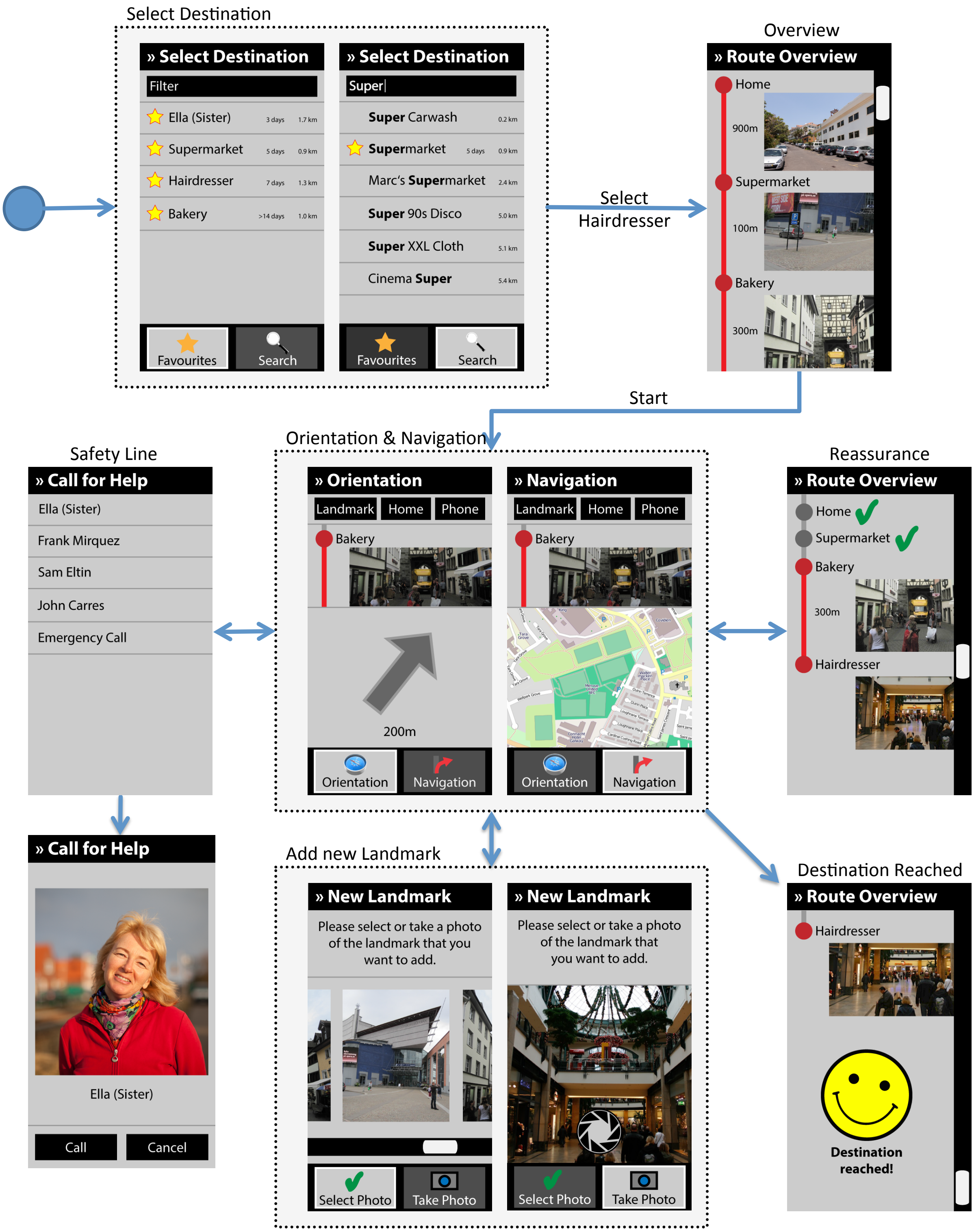


Figure 3: An overview of the overall NavMem concept.

4.1 Destination Selection

A very crucial part of the user interaction is the selection of the destination. In our sketches we envision two types of destination selection.

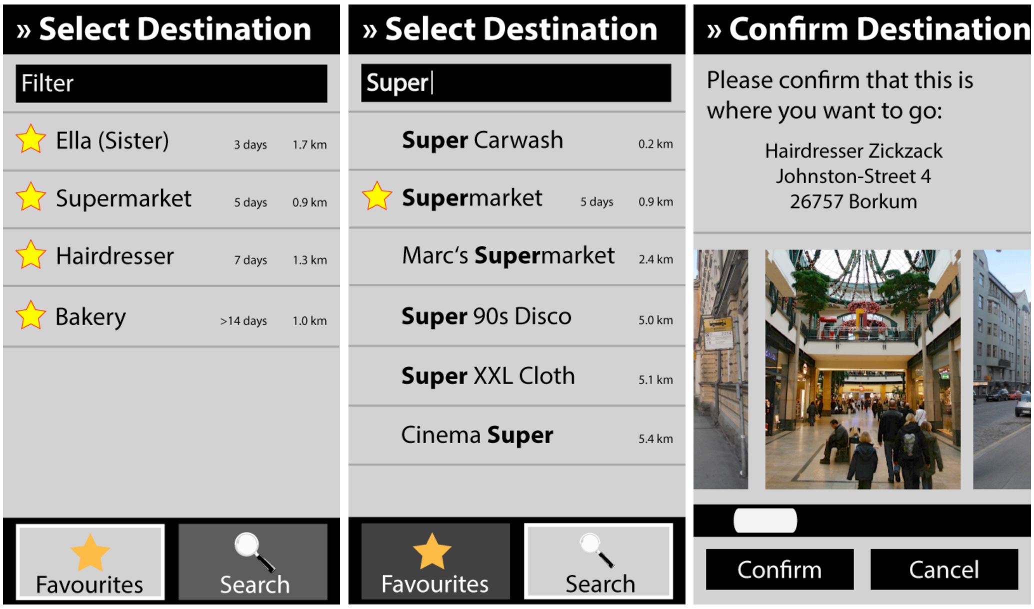


Figure 4: The destination selection can either be done by selecting a favourite (left) or by searching for the landmark (centre). Landmarks which are not marked as favourite need to be confirmed (right).

First, the sketches show a search function (see Figure 4). The user will be allowed to enter any information, e.g., type of the landmark, name of the landmark, complete addresses. An intelligent search will look for matches and propose potential landmarks or contacts nearby (UC2, UC3). Before the user decides to select one of the results as destination, he has to confirm that this is really the intended destination (AC5). To do so, various information sources will be used, depending on their local availability. Current research indicates that either location information, which is visualized on a map, or photographs of this place can be used to identify a landmark as correct destination. Nevertheless, it needs further research to find out which indicators allow a proper identification of a landmark for our target group (AC2, AC3).

Second, it will be likely that a user wants to re-visit an earlier visited destination, e.g., a user goes shopping in a supermarket once a week (UC2, AC9). To avoid searching for a landmark several times, they can be flagged as favourite (AC10). During the initial search process it is up to the user to decide whether a landmark will be added to the favourites or not. Once selected, a separate tab allows a quick selection of these frequently visited favourites (see Figure 4). Following the above-mentioned example the user decides to add the supermarket to the favourites. Consequently, it will be displayed in the favourites tab, highlighted with a star icon. In later search queries already set landmarks will also come with this star icon, indicating that this landmark is already set as favourite.

Research and user studies can focus on the question how exactly the favourites and search results should be presented (e.g., IP8). As it can be seen in the sketches, we think that distance and when this place has been visited last time are relevant measures and allow a suitable arrangement of the landmarks. Further, research can focus on how a search result can be confirmed to be the intended destination (e.g., AC5, AC10). The sketches illustrate how existing pictures of this landmark, which can be taken from various online sources like Google Street View, could be used to confirm that this is the correct destination. However, several information sources of varying quality are available. Research should investigate which information is suited best to allow a proper identification of landmarks.

4.2 Route Overview and Progress

After the user selected the destination a route overview is shown (NO1, IP1, IP2). This list-like view is scrollable, starts with the current location on top and shows important landmarks that the user will pass on the way to the destination (see Figure 5). The last entry is the destination. A coloured circle, placed on a vertical bold line, represents each landmark. The bold line with distance information interconnects the entries, similar to very abstract, but easy to remember metro maps (AC9). For each landmark the name and an accompanying photograph is shown, making the visualization personalized and less abstract (AC3). We argue that this abstract and personalized visualization is a good approach to fulfil the user's need to have a simple overview, but perceive some kind of familiarity with each route element.

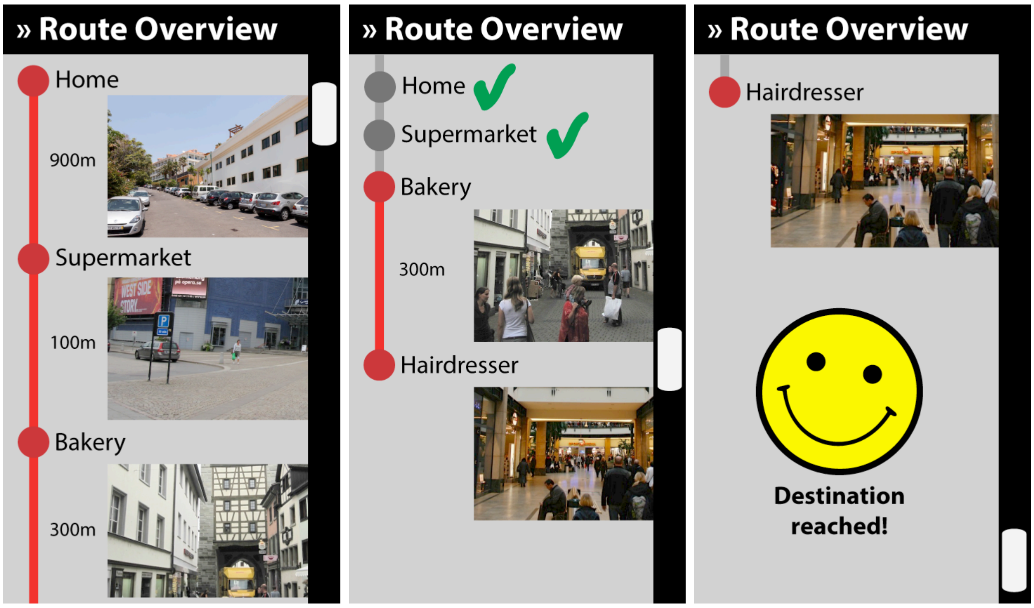


Figure 5: The route overview is a reoccuring element in the NavMem prototype. It will show the whole route in advance (left), the progress while navigating (centre), and indicate if the user has reached the destination (right).

The described view has several occurrences in the NavMem user interface sketches (AC3, IP5). An overall route overview is displayed before the navigation starts (Figure 5, left). This contains all route elements without any modifications. It can be used to train and foreshadow the whole trip. Further, the visualization concept is used during navigation and orientation to indicate the next important landmark to go to as well as the final destination (IP2, IP31, IP32). In addition, the visualization is used in a reassurance function. If the user reaches or passes one of the landmarks, the whole route and the user's progress is visualized (see Figure 5, centre). We argue that this can increase the user's confidence, but also encourages the user to re-consider other available options, e.g., to go back home if the user feels too exhausted. If the user successfully reaches the destination, a happy smiley indicates that the destination has been reached (see Figure 5, right).

In an implementation a complex route engine will back this view (NO1, NO2, NO4). This engine will find a good compromise between the shortest, but also familiar path to the set destination. Further, it will continuously monitor the user's progress and adapt the visualizations accordingly. Various exceptional use cases need to be considered, e.g., the user might decide to skip a landmark or decide for another route. Accessible routing will be inherently supported, depending on the user's individual needs and capabilities (NO4).

The route overview, being one of the core components of the NavMem interaction concept, offers many possibilities for research and investigations in user studies. The presented sketch just contains little and very simple information. We may identify further information needs in studies and can think about how this representation can be extended, without becoming too overwhelming. Further, it is questionable how the progress should be visualized. Our current sketches use colour changes to indicate the current position. However, this can be unintuitive and need further improvement. Another question is which metrics should be provided. In our sketches we use kilometre, but travel time can be another option. Further research can investigate how intermodal transportation can be smoothly integrated in this overall concept.

4.3 Orientation and Navigation Modes

Orientation and navigation are the core components of the NavMem application (NO3). Both modes are combined in one single, tabbed view (IP4, IP5, IP19, IP21). This allows the user to quickly change to the mode that suits the situation best. Both views have in common that they permanently show the next intermediate landmark to reach (AC2, NO5). Further, both views allow adding a new landmark. The significant difference lies in the different navigation instructions that the views provide (see Figure 6).

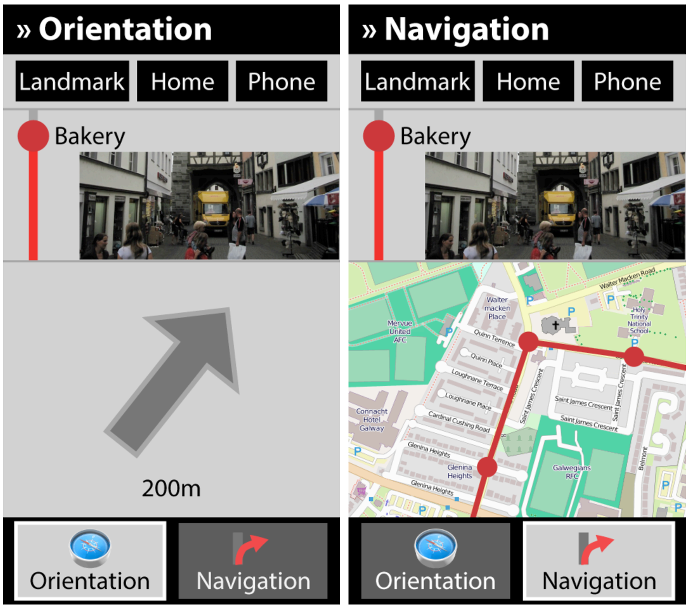


Figure 6: These two views are visible during the actual trip. The orientation mode (left) provides the user with very basic information. The navigation mode (right) shows a map-like overview, which provides more orientation and navigation details.

In orientation mode only minimalistic instructions are presented. A simple arrow pointing in the direction of the next landmark might be sufficient (NO1, IP1). This visual information might be accompanied by non-visual cues, like vibrations or audio (IP7). We argue that this mode and information detail are perfectly suited if the user is very familiar with the environment.

In contrast, the navigation mode provides the user with more information. Our sketch shows a map representation, which in itself allows many further adaptions. In example, irrelevant map information, like highways or certain point of interests can be excluded, while particularly important information is highlighted. Thereby the user always gets the maximum desired information with a minimum on additional background information. The map will be interactive at any time to provide orientation beyond the user's current context.

Beside a user-triggered mode change, also automatic mode changes will be possible (NO5, NO6, LL2). The NavMem application will continuously monitor the user and will automatically switch to the most suited mode whenever necessary. When the automatic switch should be performed should be subject to further research. Appropriate methods to investigate this topic are machine learning and data mining techniques.

4.4 Landmark Definition

The whole interface concept relies on personalized, individual landmarks (UC1–3). These landmarks can either be retrieved through existing data structures, e.g., map data, or through custom-made entries (IP6). The user will be in control to add and define new landmarks. A landmark can be added anywhere during the navigation and orientation (IP24). If the user recognizes an interesting or familiar building, the "add landmark" button can be pressed. Then, the user is asked to confirm the location, and select or take a photograph of the landmark (see Figure 7). Further, it will be possible to label the landmark however the user likes, whereby a default label will be proposed.

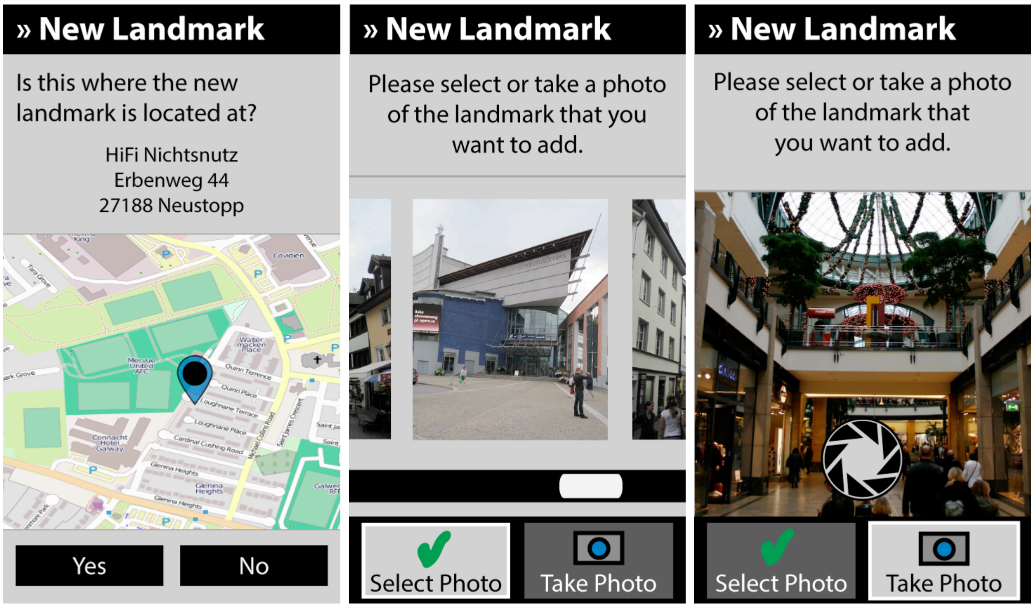


Figure 7: New landmarks can be created by the user and will be integrated in following navigation tasks. Part of the creation process is the confirmation of the landmark location (left). A supplemental photograph of the landmark can either be selected from existing sources (centre) or taken by the user (right).

Once the landmark is defined it appears in selectable destinations. Further, the routing engine considers this landmark as one of the in-between stations, making it appear in the route overview and in the reassurance screen (AC6).

4.5 Home Place Definition and Immediate Home Guidance

It might be the case that the home place needs to be re-defined, e.g., if a user moves to a new city or is travelling. We envision that the user is able to specify the current home location before a destination is selected. It is only possible to specify one home location at a time (see Figure 8). Right after the specification the home location is used for all home-related activities and actions, e.g., the immediate home guidance, which can be triggered if the mobile phone starts to run out of battery (AC5).

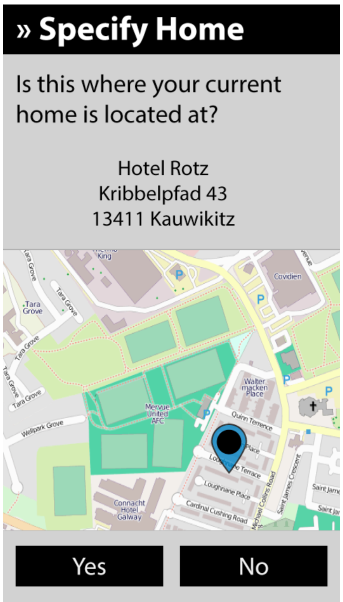


Figure 8: Occassionally a new home location might need to be defined, e.g., if a user has moved or is travelling. Consequently, it is possible to specify a new home location like shown above.

Home is most certainly a place, where the user feels safe and secure. Consequently, one action that is very present is to be guided there immediately. Without any adjustments this action starts a route calculation back home and guides the user there immediately.

4.6 Call for Help (Safety Line)

If the user loses orientation and all NavMem concepts are unable to reorient the user, personal assistance is required. Therefore the application provides the 'call for help' function, where a selection of relatives and/or caregivers is listed (LL2, LL4, LL5). For each contact it will be possible to enable the remote tracking functionality in the system settings. Further, there is the option to call the local emergency service. Further, the relative will be able to phone the user (LL6).

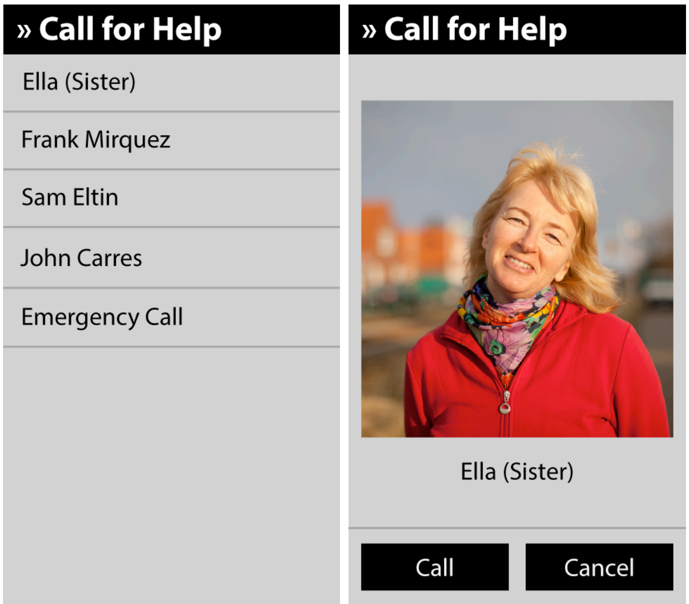


Figure 9: If the call for help function is enabled, a list of possible supporters is shown, e.g., caregivers or family members (left). Once a person is selected, it can be modified whether tracking should be enabled or not. A voice connection can be created by pressing the green call button (right).

Once a person, for whom the remote tracking was enabled, is selected, the tracking is automatically started. If this tracking support is not needed or was not enabled for the called person, just a regular voice connection is established. Remote tracking data contains details about the location, the taken track, destinations, etc. This information will be available to the called person, providing further information for remote guidance over the voice connection.

4.7 Sensor Use and Calibration

The NavMem interaction concept makes use of sensors, like GPS and a digital compass. These sensors have varying accuracy: GPS might become inaccurate because of bad weather conditions; the compass' accuracy degrades over time because of external interferences. Since these inaccuracies can have severe effects on the user orientation, they must be continuously monitored and considered in the logic and interaction (AC5, AC6).

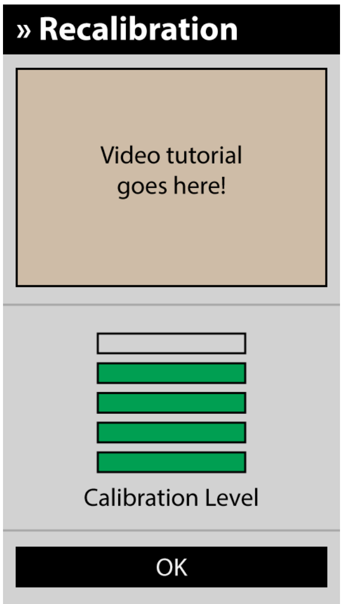


Figure 10: The NavMem application tries to avoid a recalibration of the sensors. However, if it is necessary the user is confronted with clear instructions. Independently of the success of the recalibration the application will continue to work, but with limited capabilities.

Whenever possible the received sensor information is crosschecked with other sources of information, e.g., map data when creating a new landmark. If the information cannot be backed with other data, the user should be aware of existing inaccuracies. This is realised with very simple status displays, which do not require any knowledge about the technical details of the device (IP14, IP30). Further, the user might be asked to assist in recalibration procedures, e.g., by rotating the phone along all axes to recalibrate the compass (AC3).

4.8 Battery Management

If the phone runs out of battery the user is neither able to use the navigation functions nor to call for help. Consequently, it is best if this never happens (AC5). The NavMem application tries to avoid this scenario by continuously monitoring the battery level. Once a critical level is reached, e.g., the user is unable to reach the destination with the remaining battery, the user is alerted and the application starts counteractions (IP14, IP8). Potential counteractions could be to guide the user back home or to a nearby landmark and then call somebody for on-site assistance (LL2).

A server collects coordinate IDs

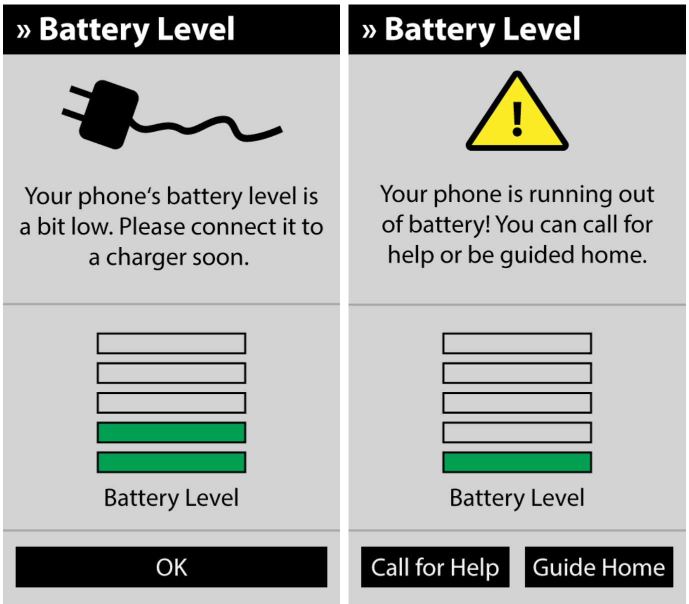
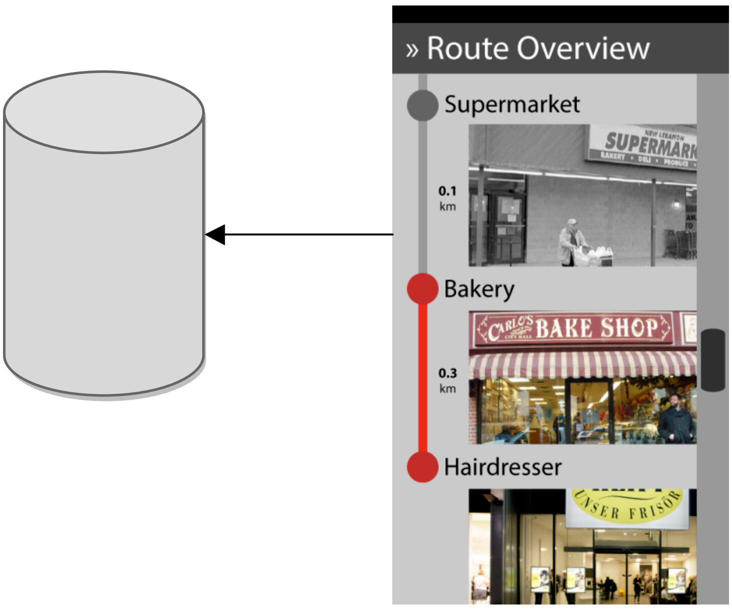


Figure 11: NavMem remembers the user to charge the phone, e.g., after a trip. If the user is outdoors and the phone running out of battery s/he can decide to call for help or be guided home safely.

The application will remind the user to put the phone on the charger when coming home or arriving at the destination. Further, the battery level will be communicated to the end-user before a trip is started. Consequently, the user will be able to assess if the phone will last the whole trip or if it needs to be recharged beforehand.

5 Envisioned Functionality of the Remote Tracking Application



“Hello, can you help me get to...” Klarabergsviadukten

Figure 12: NavMem sends coordinates and an ID to a server every x sec. After a predefined amount of time the coordinates are erased.Coordinates are stored in case the user needs help to navigate from a bystander who can observe the user on a map.

As soon as NavMem is active coordinates together with an ID are sent to a server every x seconds. Coordinates are erased in the database after a predefined amount of time. Coordinates are only meant to be displayed in case the user activates the alarm function.

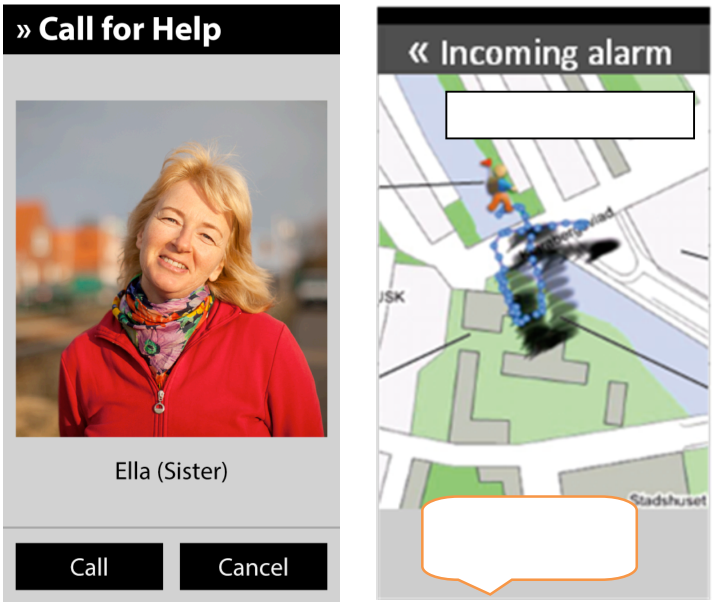


Figure 13: When an alarm is activated the receiver of the call can see the user on a map.

When an alarm is activated by the user an SMS/E-mail with a link to a web map is sent to the person who receives the alarm. Coordinates from the last five minutes before the alarm was sent are displayed on the map (web or mobile). The person who receives the alarm can see where the user is at the moment and where he/she has been the last few minutes. In that way the user can get help to navigate from the person receiving the alarm. A time stamp can be shown in the map in adjacent to each point representing a coordinate. It is also possible to show the nearest street address on the map.

6 Summary and Future Work

In this deliverable we clustered and reviewed the user requirements. Based on these requirements we iteratively refined a design for the NavMem user interface. We illustrate the simple and advanced in-situ orientation and navigation concepts as well as the remote tracking and guidance component.

In the future we will build initial prototypes, which cover certain unclear aspects of the overall design, and evaluate their individual advantages and disadvantages with users. Based on these results we will be able to make an informed decision how the first prototype for the first longitudinal large-scale study should look like.