Project Number AAL-2016-049	**Active and Assisted Living Programme** **AAL-2016 – Living with Dementia**	

An Intelligent Location Monitoring System

Deliverable D2.4

Usability Concept

Work package:	WP2 – Requirements & Design
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CARELINK Project Profile

Contract No.: **AAL-2016-049**

Acronym:	Carelink.
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Twitter	@Carelink_AAL
LinkedIn Group	Carelink
Facebook Page	www.facebook.com/Carelink
Start Date:	01/08/2017
Duration:	30 months

Partners

TSSG	WATERFORD INSTITUTE OF TECHNOLOGY (WIT) - [COORDINATOR]	IRELAND
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AKADEMIE Offen für Neues BERLINGEN	AKADEMIE BERLINGEN (AKA)	SWITZERLAND
CREAGY	CREAGY AG (CRE)	SWITZERLAND

Active and Assisted Living Programme
AAL-2016 – Living with Dementia

Document Control

This deliverable is the responsibility of the Work Package Leader. It is subject to internal review and formal authorisation procedures in line with ISO 9001 international quality standard procedures.

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0.1	18/10/2017	Philip O'Brien, TSSG	Document Written
1.0	02/12/2018	Gary McManus	Approved version release.
1.1	21/07/2020	Gary McManus	Review & Edit based on current project position
1.2	21/10/2020	Jorge Calado	Adding in HW specifics
2.0	27/10/2020	Gary McManus	Approve new version release.

About this document

The CARELINK system will be comprised of a wearable tag for dementia sufferers which will be supported by a wireless sensor suite developed to provide proximity and location information for the wearer and reporting this information back to a cloud-based platform that supports personalised connected solutions. The Carelink platform will allow Carers to monitor the proximity and location of persons with dementia and receive alerts if the wearable sensor deviates outside a given safe zone.

The purpose of this document is to set out the usability concepts and requirements for implementation in the overall software front-end solution for Carelink. To ensure that the software is easy to use it is built with a structure that gives the software a natural look and feel, enabling users to navigate through the software with ease and provides the solution with accessibility that is needed for the target audience of Carelink.

Abbreviations and Acronyms

Abbreviation	Description
PwD	People with Dementia

Figures

Tables

NO TABLE OF FIGURES ENTRIES FOUND.

1. INTRODUCTION

Problem

An estimated 50 million people worldwide live with dementia, with an increase of 10million new cases each year. The total number of people with dementia is projected to reach 82 million in 2030 and 152 in 2050. This is a disease that is overwhelming for both the people who have it, but also their family and carers. Within Carelink, we are addressing one specific aspect of the problem; the wandering of people with dementia. Six in 10 people with dementia (PwD) will wander. A person with dementia may not remember his or her name or address, and can become disoriented, even in familiar places. Wandering among people with dementia is dangerous, but there are strategies and services to help prevent and manage it.

Solution

Carelink provides a low-cost solution for the person with dementia in combination with a smartphone app for the caregiver, both connected to the Carelink platform. In the project we have developed a belt clip-on as well as a shoe sole, but the platform will be open to device manufacturers to allow other smart devices such as smart glasses, etc. to be plugged in instead.

Carelink gives people with dementia the possibility to walk freely while reducing the stress on the caregivers - all based on a smart, low-cost device and a caregiver app. Based on our intelligent location monitoring system, the Carelink solution will have positive impacts, specifically on the quality of life of PwD and their caregivers. Besides, the usage of Carelink has the possibility to lower the overall healthcare costs as people with dementia may live longer in their own apartments instead of moving early into a nursing home.

Usability

The Usability Concepts & Requirements are a big part of the Carelink solution. The target audience of the software are carers, who may be elderly people, and who may have little or no knowledge of technology. Because of the target audience it is important that the software is easy to use, and that you do not need any knowledge of technology to operate it. With the user interface created for Carelink, the consortium partners believe that it is possible for users with little or no knowledge of technology to use a computer or mobile device and can therefore receive some of the benefits that are accompanied by the use of our technology.

2. EXECUTIVE SUMMARY

The CARELINK system will be comprised of a wearable tag for dementia sufferers. A wireless sensor tag suite will be developed that has the capability of providing proximity and location information for the. Additionally, a cloud-based platform will be developed to support personalised connected solutions. This platform will allow Carers to monitor the proximity and location of patients.

In this document we outline the principle guidelines that were used to build the user interface, taking on board key areas that would be specific to our end users. We then provide an overview of the usability concepts and requirements that were considered in the design of the interfaces and interactive components. We detail the User Interface showing the results of the work as well as the hardware components that were built to interface to our platform. And finally, we provide an overview of any changes that were taken on board as a result of tests and trials of the overall system

3. PRINCIPLES & GUIDELINES

The aim of this section is to assess how and to what extent we take into account the usability and accessibility needs of the users, a possibly ageing population, in the design process of the Carelink solution interfaces.

In an early stage, a search was conducted among the available relevant literature to retrieve all of those that included guidelines for evaluating and/or designing interfaces aimed at elderly people and their carer. This was enhanced through a series of user interviews and the amalgamation of the two were brought into the requirements for the Carelink application and interface. The following 4 guidelines: screen design, text formatting, menu design, content and language were used in the design of our application to cover the various interaction elements

Screen Design

In the design of the screen layout we looked at the display size, ensuring that our display is large enough and clear enough for better readability. We looked at colour, ensuring that there was sufficient contrast between background and foreground, allowing for easier deciphering and picking out of the interactive elements

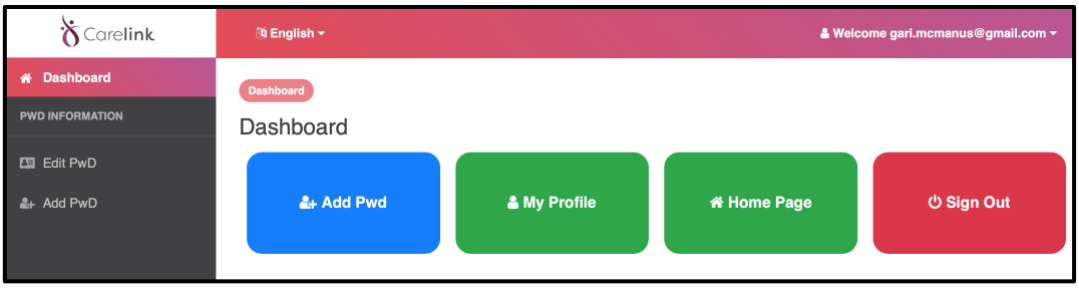

Figure 1: Screen Design

Text Format

We have chosen a clear font-type () that works well in various sizes, with suitably sized font-size to ensure that our users have no difficulty in reading all buttons, menus or general text fields.

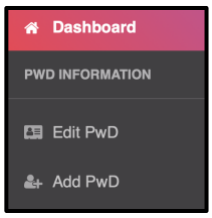

Figure 2: Text Format

Menu & Buttons

As the carer user may include elderly people and therefore may experience problems understanding the menu on devices, we have built a simple menu format for ease of use, and to avoid complications and used clear distinguishable buttons. As such, our design is:

- Simple

- Consistent
- Has minimal nesting
- Easy to navigate
- One-level menu navigation

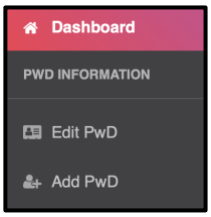

Figure 3: Simple Menu Design

Content

In building the content we have made sure to keep things simple. The terminology we have used is aligned with the problem that the solution is designed for and is simple, consistent, self-explanatory, and non-ambiguous. The content is appropriately located to allow for natural flow and ease of finding, and appropriate error messages are kept straight forward and simple in order to avoid complicating and confusing Carelink users. We have considered the spatial relationships between items on our pages and structured the pages based on this importance. Careful placement of items draw attention to the important pieces of information and aid scanning and readability of the overall site.

Language

In our solution we have selected the three main language configurations for the anticipated trial users and translated all system pages and text to suit. In all cases we have used language that is clear to the user on both labels and messaging.

Figure 4: Language Configurations

By utilising these design features, we focus on the anticipating of what users need to do and ensuring that the interface has elements that are easy to access and understandable to all.

4. USABILITY REQUIREMENTS

In the following paragraphs we describe the project infrastructure and the user interface proposal.

Initially we define the different user targets and dedicated instruments to engage with them.

Admin users: these are systems admin users, part of the CARELINK organization and they need tools to setup, administer, and deliver the environment for installation.

Caregiver: this user is a caregiving organization manager/ administrator or an informal carer. This user need tools to setup multiple PwD to be monitored within the caregiving organization environment, to create and give authorization to users, and to view general system status.

Relative/Informal carer: this user is a relative of the PwD. Similar to the formal carer, they will require access to the system to create the profile and create safety zones for the individual PwD. This user needs a tool for a fast monitoring and reporting of the PwD who is under their responsibility.

The goals we are hoping to achieve within our system for each of the users are:

Create and setup environment: an environment is a specific configuration for a caregiver organization or a simple family. The environment is composed of admin screens to set up PwD as well as creating the safe zones that need to be monitored for the PwD. In this environment we can have a caregiver administrator, one or more caregiver assistants or one or more relatives and one or more PwD to be monitored. The environment is a closed system and does not have communications with other environments regarding the data collected.

Monitored data: the capability to monitor route data and perform data analysis for a PwD.

Alerts: Alerts are push notifications that give location information about the PwD when they step outside of a specified safe zone.

Communication by SMS: The goal here is to provide a fast easy access to location information for the PwD to the carer.

The Carelink solution is dedicated to the Caregiver in charge of the PwD, and the UX must be a simple to use, clear with fast response times in order to make it as easy as possible for the user. The alerts are the most important feature used in the location of PwD going beyond safe zones. These alerts will be push notifications sent directly to the carers chosen phone number.

5. USER INTERFACE

To make sure working with Anne is easy and feels natural the software is built with a recognizable and simple design. All screens give clear overviews of all the required functionality for that stage and have been built with ease of use in mind.

In the first instance, the user is presented with the Home screen which provides them with the option of logging in or creating a new user account.

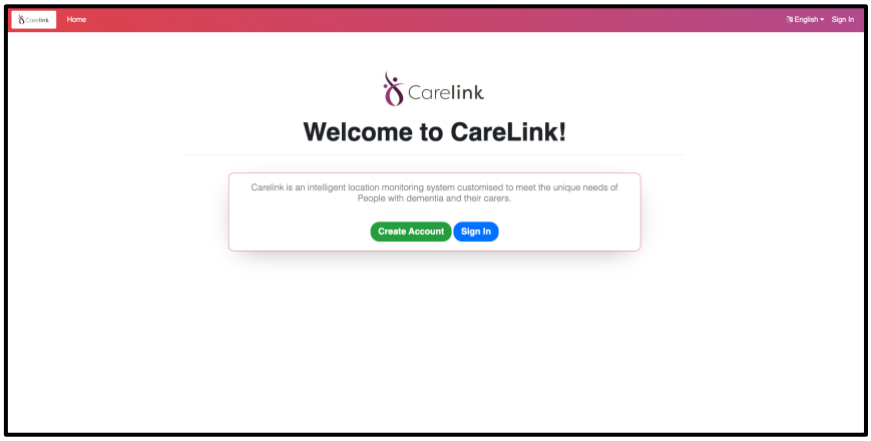

Figure 5: User Home Screen

If it is their first visit to Carelink, then a user account will need to be created before they can progress any further. At this stage we are capture just the minimum details required to set the user up.

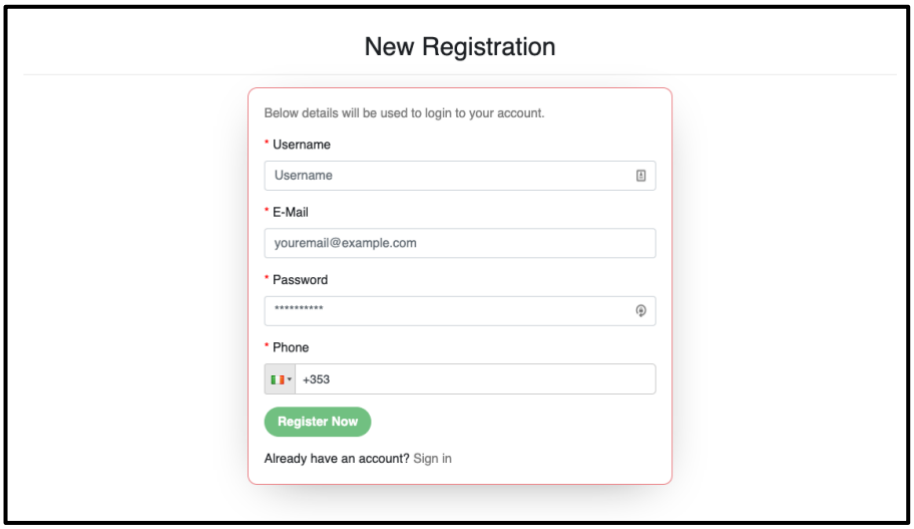

Figure 6: New Registration Screen

Once the user account has been created and a user has logged in, they will be brought to the main dashboard for the Carelink application, which is kept simple for ease of use.

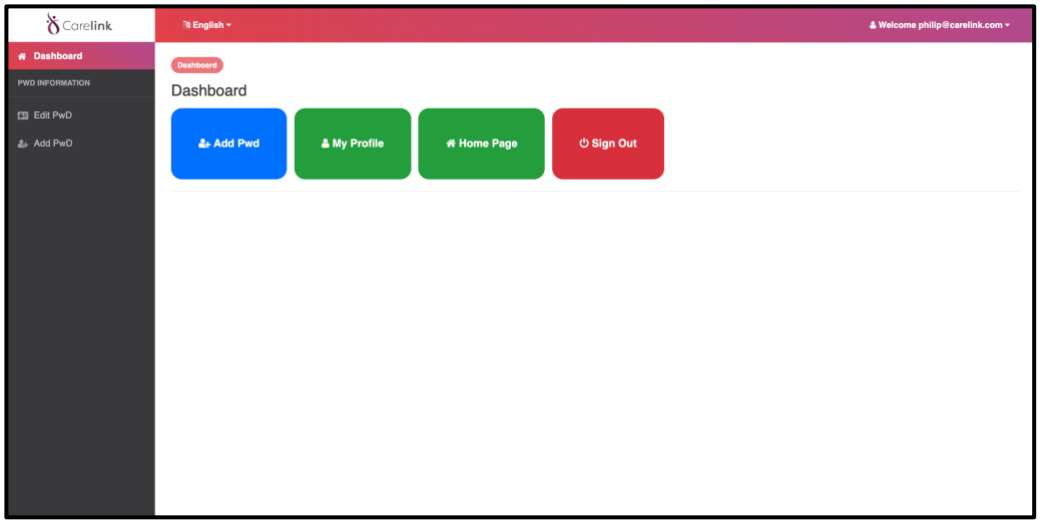

Figure 7: Carelink Main Dashboard Screen

The dashboard screen immediately shows all the functionalities the software provides for the user. Each functionality has either a large icon or clear text to ensure visibility, even allowing users with deteriorating eyesight to see them clearly.

From this dashboard you have the possibility to:

- Add PwD
- Edit PwD
- Edit My Profile
- Return to home page
- Sign Out

Once logged in and wanting to add a PwD the user either clicks the button or selects the text 'Add PwD', and they are brought to a screen that allows them to enter all relevant details.

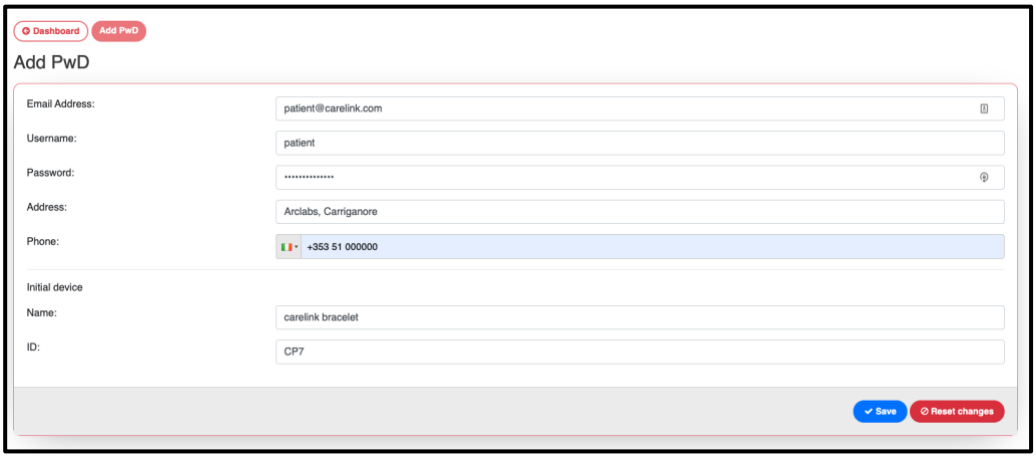

Figure 8: Add PwD

After PwD has been added there is the facility to edit their main details, as well as adding in devices to be associated with the PwD or else specify the safety zones pertaining to the individual. When clicking the Edit PwD link the user will be prompted with the following screen which will give them the ability to address the following:

- View Details
- Edit Details
- Add Safety Zones
- Add known locations
- View previous routes

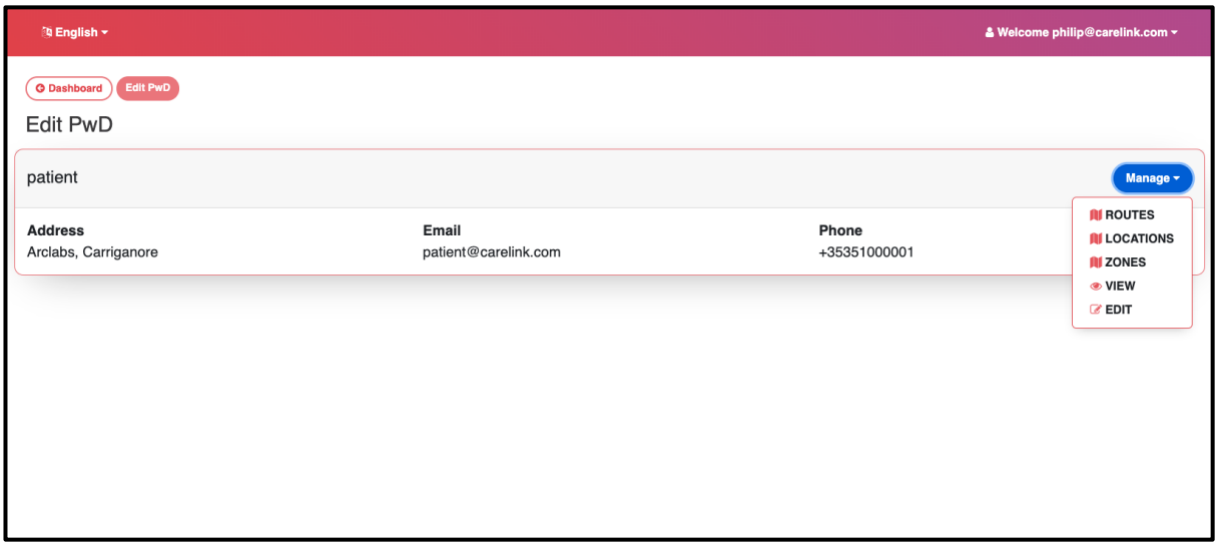

Figure 9: Edit PwD Profile Screen

An important aspect in the editing of the PwD details is the associating of a Carelink device with the PwD (FIGURE 10). As part of this process, we can assign any name to a device, thus making it distinguishable amongst multiple PwD's under care. However, the device ID is specific to a hardware component and is therefore taken from the physical device e.g. CP7.

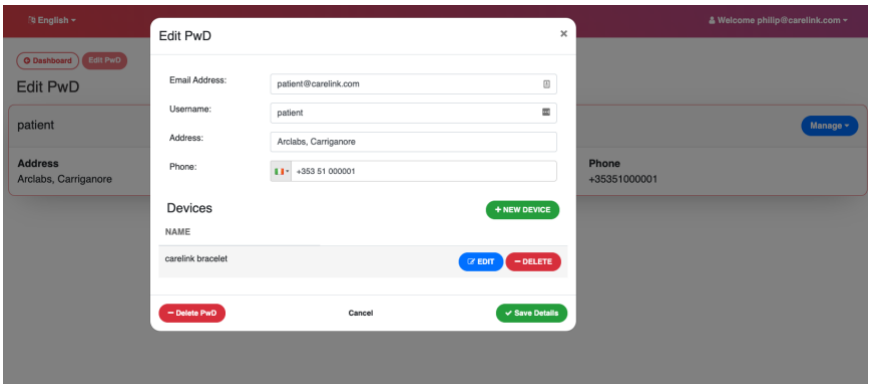

Figure 10: Associating device with PwD

Once the PwD is set up and the Carelink device has been associated with them the user is given the option to create either safe zones or unsafe zones for the PwD. Again, this is done in a manner that is as simple as possible. They are created simply by selecting the 'draw polygon' button on the map, and then clicking the map directly to create the zone. Clicking on the first point completes drawing the zone. Clicking the

drawn zone then allows you to name the zone and specify whether it is to be considered as a safe or unsafe zone.

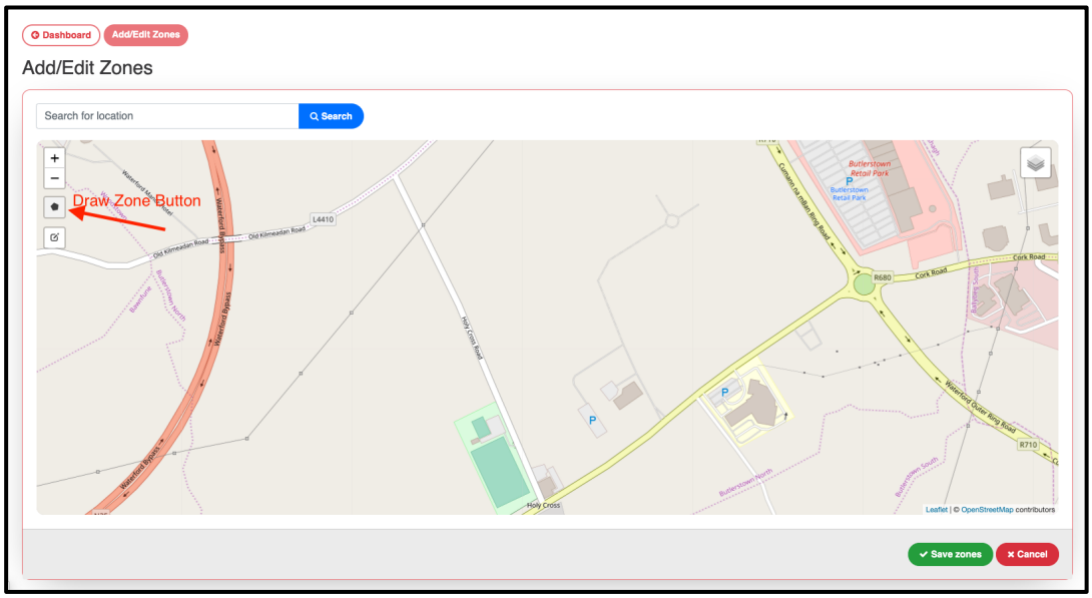

Figure 11: Start defining Safe/Unsafe Zone

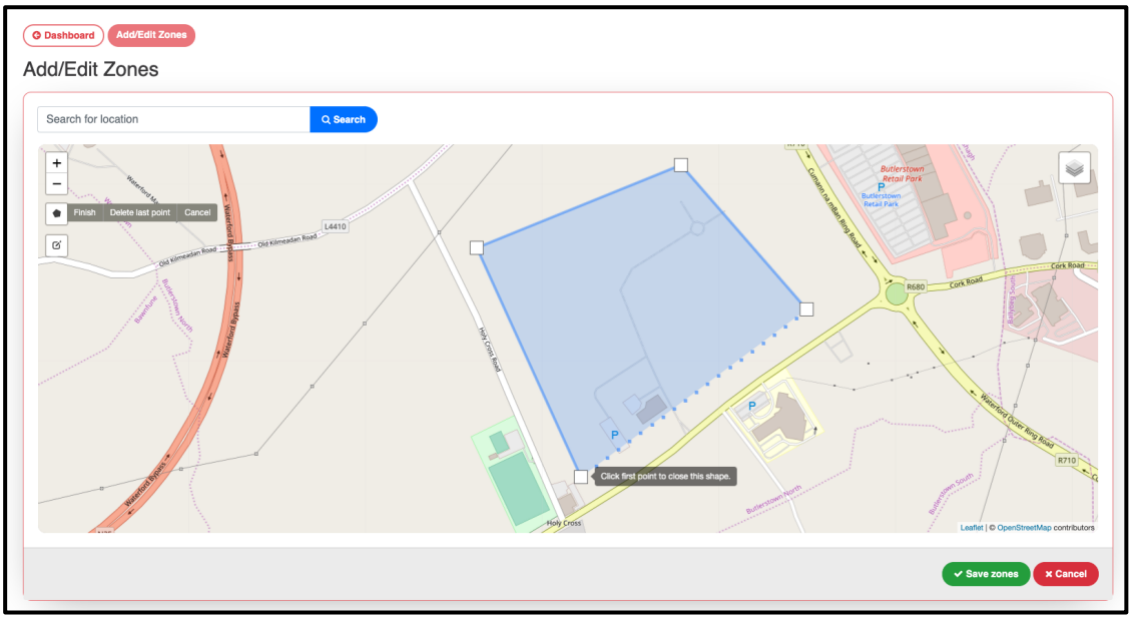

Figure 12: Draw Safe/Unsafe Zone

Once you have the zone completed you have the option of saving the zone, and continuing to create new safe/unsafe zones. In order to save the zone name, you simple select the zonal area and you will be provided with a pop-up screen that allows you to enter name details.

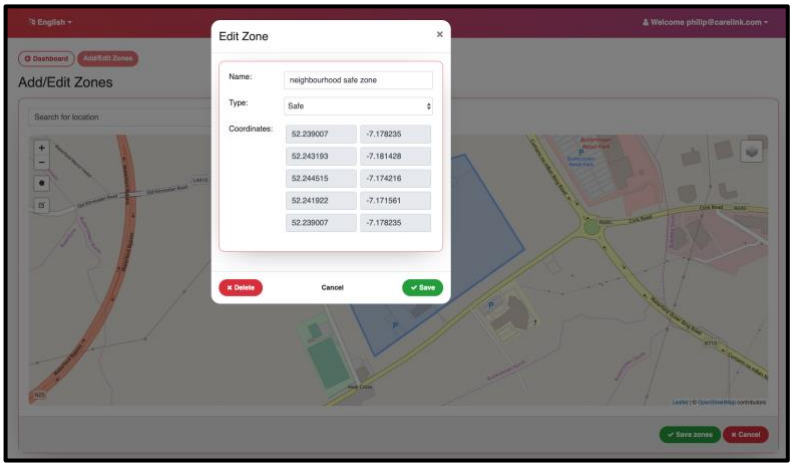

Figure 13: Save name of zone

Once the user is created, and all PwD's associated with the user have been set up on the system the next stage of the design was towards the presenting of message to the user once their PwD starts moving outside with their registered Carelink device. Location details for the PwD will be analysed by the platform, and if their current location is outside a safe zone or inside an unsafe zone, an alert will be sent to the registered user. It was decided that this alert will be sent via an SMS, and it is important that the message contains a map link that will bring them straight to a web view of the location of the alert. Below is an example of the SMS alert and the view of the map that the user is brought to on their mobile device.

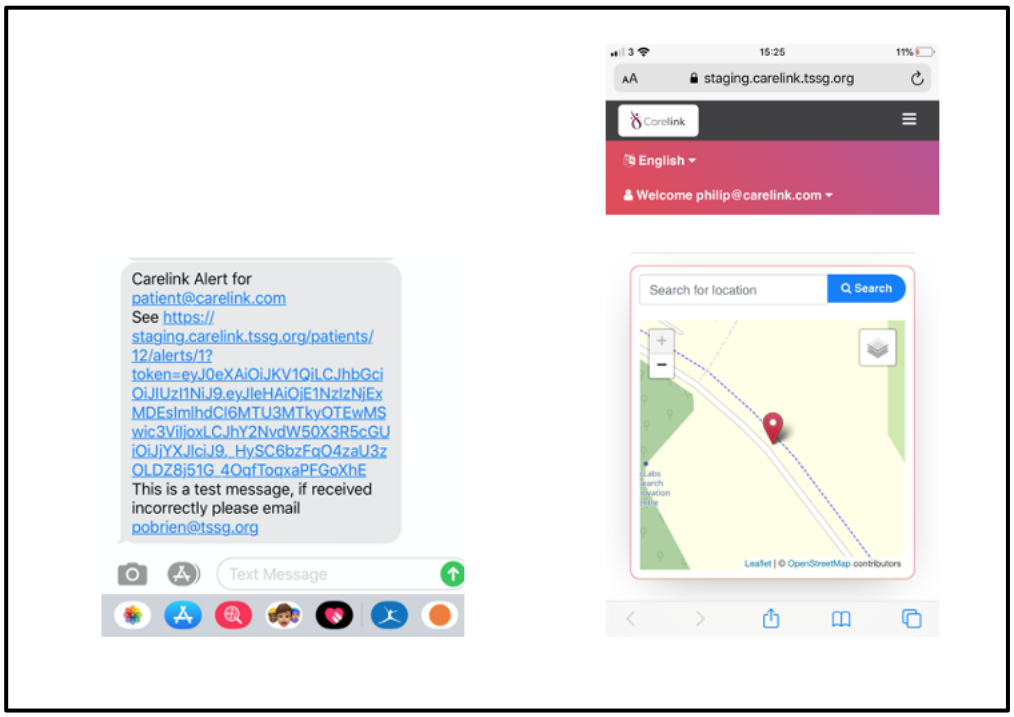

Figure 14: Carer Alert Screens

6. HARDWARE COMPONENTS

To design and model the casings for the hardware boards, respective antennas and batteries, different measurements of the board's components were required, in order to study the possible configurations arrangements and viable solutions.

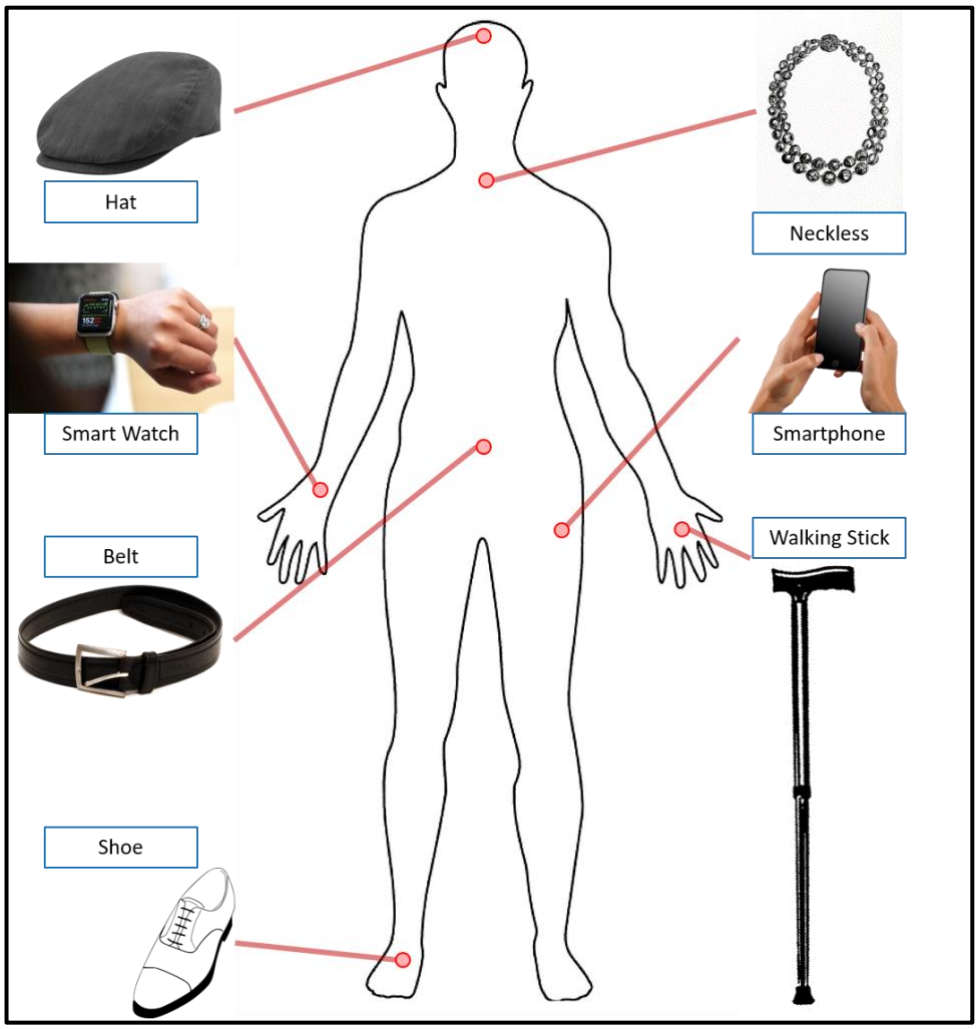

Figure 15 - Hardware-Wearable Integration Possibilities

During this study, two situations were analysed, the insole and a box with a clip for a belt or for an arm band.

After choosing the insole as a wearable tracking device a layout study was performed. As the natural movement of the foot is folded in the front area and all the electronic components have to be properly protected the chosen place to allocate these components was in the heel zone, the green area in **Figure 16Error! Reference source not found.**, since it is the most stable are on the insole.

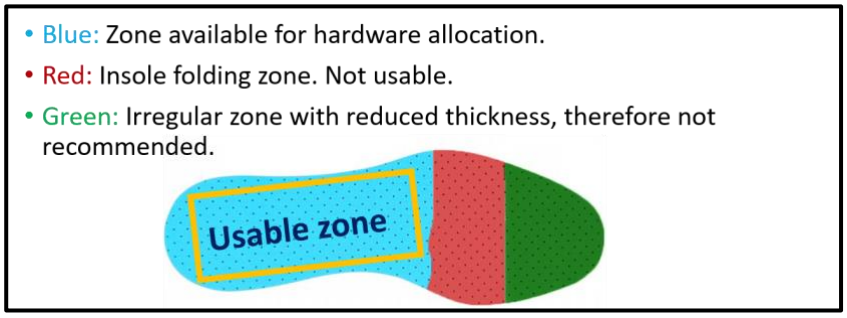

Figure 16 - Insole Usable Areas

A set of design specifications were defined during this study, such as:

- Lightweight – so that the person does not get tired while using the insole.
- Thin - so that the insole can be inserted in any kind of shoe.
- Ergonomic - the insole should be comfortable so it can be effective.
- Waterproof - to protect all the electronic components inside the insole.

Since the insole is meant to be ergonomic and comfortable, a proper insole made with ergonomic features, such as lateral arch as a support and a block heel to prevent the foot moving will be placed on top of the electronic housing. In all of the layout options the electronic components will be place on a rigid housing under the heel area. This rigid housing is the reason that this study is mainly focused on the heel area. After the layout study a material was selected in order to build the heel housing, this material is based on polypropylene (PP). The PP is flexible olefin polymer that resists breakage. This material is soft and non-brittle and offers a good cushioning and shock absorption performance, which means that is suitable for use in shoes as an insole.

After rearranging and optimizing the components and layout positioning of the insole the final arrangement was achieved, using the Sodaq board as the most viable insole solution. However, a solution using the Pycom board was also developed for comparison of the usability, between the two different sizes.

After studying the insole application, we replicated the efforts with the difference of adding the tracking device into a small box with belt clips, which can be fixed t the wearers belt and offered as a wearable tracking device.

7. CONCLUSION

The Carelink research and development team engaged in the project developments with the clear view that most of the potential users include people that could have difficulties in handling technology, which applies to patients and, in some cases for the caregivers. With that view in mind, the hardware was developed aimed to be the most unobtrusive that would allow presence and functionalities without handling skills needed. On the other side, software is created for a target audience that may include elderly users with little or no knowledge of technology. So, as a fundamental specification, Carelink team assumed the importance of the usability of Carelink platform and devices, resulting in a user interface is simple and easily recognizable for the users. This can be guaranteed by the basic interfaces and rules that are applied in the software, ensuring that each functionality follows the same layout and as such that the software is always recognizable, and the end-user always knows where they are in the programme. In what regards to hardware, much effort and brainstorming resulted in increased awareness for the researchers to know what is fundamental and what addresses the different profiles of Dementia patients. The knowledge and sensitivity for the problems patients and carers face resulted from interviews, consulting patients, medical staff and operational personnel from the patient associations. Baring the collected opinions and reflecting on the importance of using hardware that is comfortable to wear and not a nuisance or hinderance to the wearer some solutions were developed. Taking comfort, usability and technological efficiency as guidance on development, some solutions were studied. The most popular choices, when carrying out requirements gathering, pointed as final outcomes the insole solution and belt-clip box. Those solutions combined simplicity, comfort and effectiveness as, hopefully, patients do not leave facilities without shoes and in the mild cases it is possible to ensure that a belt clip is used and deploys the needed services for Carelink. Again, aiming the proposed requirements, much effort was put into ensuring battery, communications and sensing capabilities to be housed in an insole that, nevertheless, would allow patients to use the shoes of their preference, which is a must resulting from lessons learned from carers. The team concluded that, due to the specificities of Dementia patients and their carers, Carelink reached balanced solutions that promote security, comfort and usability for the adoption of Carelink driven solutions.