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HelpWave: an integrated web centred system

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Abstract

In developed societies populations are aging. Facing the global slump states are reducing expenses bringing crisis to health care systems. Solutions to decrease costs are needed.
Within ICT, smartphones' features can help provide personalised health and care services that meet individual needs. There is a huge rise of applications that effectively help people but they act independently, each one for a certain purpose.
In this paper we propose the HelpWave system, a cloud-centred architecture information system that integrates data from the users' smartphones APPs. Conceived as a social care network its aim is to reinforce connection between caregivers and carereceiver as for instance, older people.

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Keywords: social care network; older people; mobile applications; information systems; ADL.

1. Introduction

In 2011, Europe was already the world's oldest region claiming for strategies to address their consequences and creating an inclusive and intergenerational society [1][2]. In recent years developments of Information and Communication Technologies (ICT) made mobile devices increasingly reliable and affordable. The use of mobile

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devices is growing fast even among older people [3]. Several applications for mobile phones (APPs) were developed concerning characteristics and problems of this target, and include functionalities like memory aids, visual aids, haptic aids, features to minimize error, and safety features [4]. In general APPs are not conceived to share data. APPs data integration and usage routines would permit a good characterization of user well-being.

Several authors outline the importance for the third and fourth age of maintaining their social networks to improve quality of life, *e.g.* several circumstances such as retirement and abrupt relocation, can severely disrupt high quality social networks [5][6]. Furthermore it is well known that people in the same condition are more likely to help each other.

With this in mind, we came to the idea of a network of "helpers" connected through a centralized system that integrates data from smartphones' APPs, focused on the benefit of "caregiver-carereceiver" paradigm.

This paper is organized as follows: In section 2, background concepts are presented, followed by the explanation of the adopted methodology for modelling HelpWave system, in section 3. Section 4 presents the HelpWave system and finally, in section 5 we present fictional scenarios and discuss expected impact.

2. Background concepts

The use of ICT particularly smartphones, is increasingly widespread and rapidly growing in developed countries, particularly in Europe and United States [3]. Population is aging as result of the decrease of mortality along with improvements in the quality of healthcare, better living and working conditions [7]. With the global slump, states are reducing expenses bringing crisis to health care systems. On one side, an aging population increase healthcare costs, on the other government trend to shrink number of workers, the reducing pool of health care professionals and expensive new treatment options [8].

The smartphones are suited to help user as personal devices (always at hand) with plenty interesting characteristics (always improving) such as communications-centred (voice and data), big screens, high resolution/brightness/contrast and touchable, multimedia, big computational power and equipped with many sensors (*e.g.* GPS/Accelerometers/Gyroscope/ etc.).

The resistance among elderly to the adoption of ICT is well known. However, "if the benefits outweigh the costs, many older people will invest the necessary time and effort to learn new skills" [9]. According to [3] "Once seniors join the online world, digital technology often becomes an integral part of their daily lives. (…) Despite some of these unique challenges facing the older adult population when it comes to technology, most seniors who become internet users make visiting the digital world a regular occurrence." In fact, many of today's older people already use mobile phones or computers for several years [3]. Those who are now around 60 year old may not imagine their everyday life without ICT, and particularly without "mobile phones". This situation boost development of new services and new applications' focused in this group.

2.1. Social support networks

According to [6], events such as retirement, inability to drive, death of a spouse or moving to an elder care facility may negatively affect the quality of older adults' social support networks. He states that "increase or maintain the quality of their social networks may lead to enhanced cognitive functioning, decreased depression and improved quality of life."

The author of [5] reinforce this idea and adds that for older people in particular the quality of their social networks is much more important than the number of people with whom they come in contact on a regular basis. From his study he observed "greater evidence of community involvement and strengthened ties with friends and relatives compared with those who did not routinely use the new technology, contrary to the idea of the use of technology leading to isolation.

Furthermore, new concepts emerge relating "caregiving" with "care receiving" suggesting reciprocal and volunteered based networks. For example, the "Neighbour care" referred to children and mothers' wellbeing [10] and the "staccato social support" referred to a particular style of social support, enacted in mobile environments, thought for brief, rapid social sharing and interaction [11]. These concepts highlight a democratic basis of use and access to information on the web and are in tune with the social economic challenges highlighted before.

2.2. Improve information – improve care

It is well known that the quality of care is directly related to the quality of information available [12] - if caregiver is better informed (in time) he is able to provide better help.

Smartphones, as personal devices, produce huge amount of data suited to characterize the welfare of its user: a) users already use several APPs to get help on determined tasks, each generating its own information about that particular help – APPs do not share information with each other, and b) APP usages and routines, (*e.g.* how often user uses a social network, how frequently user makes calls or writes messages, duration of performing tasks or even his voice tone during communications) may be well related with his mood and wellbeing.

In our opinion, it would be a great improvement in care quality if it was developed an information system that integrates APPs shared data, analysing it using for example rules based or artificial intelligence based strategies, and able to deliver the right information to the right user – be it a caregiver or a carereceiver.

A social network of care seems to be an interesting concept for this system, allowing anyone to play both the roles of giving and receiving care, sharing some opportunistic data, capable of providing help at a certain circumstance. This led us to the HelpWave idea.

3. Methodology

As methodology for system's development we chose the traditional waterfall model. This model is a sequential design process, in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Analysis, Design, Code and Test, referenced by Pressman[13]. In this paper we present the results of Analysis and Design stages for functional perspective.

For functional modelling the proposed system adopted was the Unified Modelling Language (UML). The UML was created and developed by Grady Booch, Ivar Jacobson and James Rumbaugh at Rational Software during 1994–95 and in 1997 it was adopted by the Object Management Group (OMG). This methodology is a general-purpose modelling language in the field of software engineering and was developed to provide a standard way to visualize the design of a system [14].

Use-case diagrams represent the system functionality under the user's perspective, illustrating the system requirements and have components such as actors, use-case and relationships.

The actors represent someone or something that, being outside of the system, interacts with it. The use-cases represent a high level functionality offered by the system. A major advantage of looking at the system in terms of use-cases is the ability to separate the system implementation from the reasons for its existence. Finally the relationships can be of various types: *Association* (communication), are the relation-ships between actors and use-cases. Use-cases should always be started by an actor. Exceptions to the rule are use-cases involved in *includes*/*extends* relationships and *generalization*.

4. The HelpWave system

The main goal of HelpWave system is to help users reinforcing their inter-connection through the use of ICT, particularly smartphones. Considering the detailed characterization of user well-being based on APPs data integration and usage, the HelpWave system will enable a user (carereceiver) to share selected information with another user available (caregiver) according to level or type of care.

Thus, the system targets the caregiver and the carereceiver as central characters: carereceiver benefits from care and the caregiver provide care – both benefit from reassurement of being better informed. The carereceiver will be someone who needs care. He can be anyone. The caregiver will be someone who cares for the carereceiver. He can be health professional (*e.g.* doctors, nurses, physical therapists), family (*e.g.* son, daughter or other related), a trusted person available to help, or someone who, is willing to help and be helped.

We chose to focus our approach in older people, however we are convinced that the system can be used to help a wider group of people, *e.g.* children.

The system HelpWave will be a cloud-centred and multi-platform, including smartphones (*e.g.* Android or iOS) and PC. For this, the development of the backend system will be done in the cloud allowing, with some ease, integrate services and make them available for various kinds of devices.

The HelpWave will enable the interchange of APPs data through the use of an open protocol (*e.g.* XML, Jason) – we call it "HelpWave compatible". This integration will be done in two steps: Step 1 is intended for data exchange between APP and HelpWave sub-system and will be done by synchronizing the input and output tables. App's programmers can use existing tables, template tables provided by the system or costume tables (specified APP programmer). Step 2 uploads a script to analyse and interconnect new data with the HelpWave.

APPs usage will be done by a HelpWave App installed in the smartphone that registers the use of APPs, *e.g.* time and duration of use. This app will provide users interface (caregiver and carereceiver).

4.1. System architecture

In order to characterize the HelpWave system their main requirements were identified and presented in Table1

Table 1. HelpWave requirements.

Requirement	Short description
Automatic data collection	Automatic data collected from sensors, *e.g.* global position system (GPS), accelerometer and magnetometer
Manual data Insertion and maintenance	Insertion and maintenance of various data, such as, safe points list, therapeutic and treatment plan, food plan, carereceiver and caregivers profile, etc.
Data Queries	Includes various data queries, such as, list of caregivers, safe points list, therapeutic and treatment plan and confirmation that medicines are taken, food plan, carereceiver and caregivers profiles, etc.
Alerts and alarms	Generate and send various types of alerts and alarms to the mobile devices of caregivers and the carereceiver, such as, medication alarm and alert (when medication are not taken), possible falling alert, isolation and broken routine warnings, etc.
Interaction with others	Send SMS/email/MMS, connect to social networks, etc.

From these requirements, the system boundaries, actors and use-cases were identified, and the use-cases diagrams created. With the aim of simplifying the reading of the diagrams, the system was divided into three subsystems according to the access policy and the similarity criteria: a) use cases common to all users; b) particular features of each type of non-application user and; c) features automatically triggered by time.

Next, the actors and use-cases were identified, answering the following key questions [15]:

- Who uses the system and what roles does he play in the interaction with the system?
- Who installs and maintains the system?
- Who provides the data and who gets information from the system?
- What are the other systems interacting with our system?
- Are there specific actors requiring particular features?
- Are there external events that affect the system? What does notify the system about these events?

In a use-case diagram the actors are external entities that interact with the system - they can be people, organizations, time or other external systems. Three actors were identified:

- Carereceiver – a user who receives help from a caregiver;
- Caregiver – a user who has accepted supervise the carereceiver activity;
- Time –device's internal clock responsible for triggering events.

For each subsystem a use-cases diagram was built and presented in Fig. 1, Fig. 2 and Fig. 3.
The functionalities shared by all actors a) are shown in Fig. 1 use-cases diagram. Most of shared functions are

queries. Request for help, View and edit the contact list (list of known people) and Set and configuration intention of willingness to help, are the exceptions.

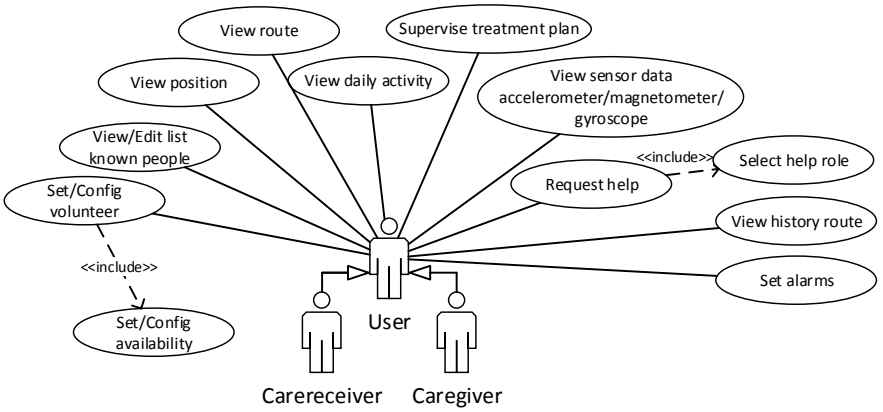

Fig. 1. Use-case diagram describing all features shared by all users.

Specific use-cases for each type of user are shown in Fig. 2. The carereceiver may collect biometric data, with the possibility to save in the database for later analysis, view safe points, validate of taking medication and communicate with other users through the various available channels, *e.g.* phone calls, MMS, SMS, among others. Additionally, the caregiver will have at their disposal several types of queries and all maintenance options, including the activation of alerts that he want to receive.

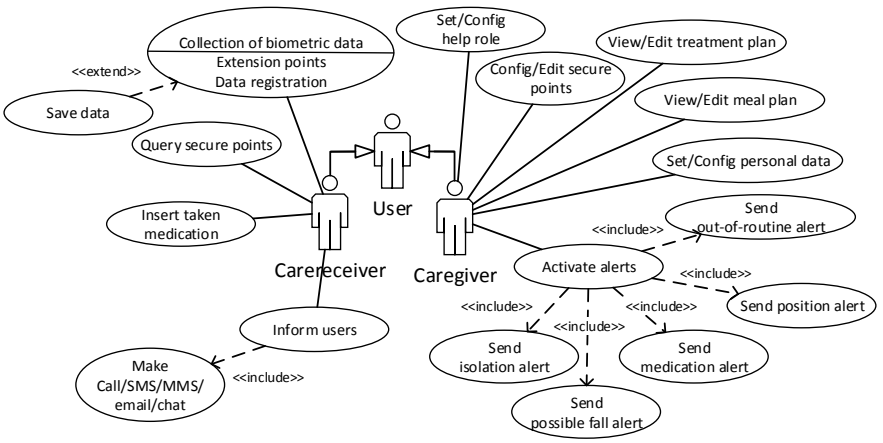

Fig. 2. Use-case diagram describing all features of the carereceiver and caregiver type of user.

In Fig. 3, it can be seen the diagram for the automatic triggered use-cases: GPS position, save route, send state the device, collect biometric user data, accelerometer data, magnetometer and gyroscope. The data sent and saved by the device depend on a previous configuration and machine characteristics.

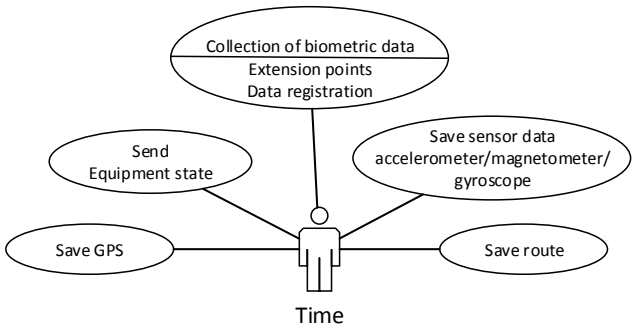

Fig. 3. Use-case diagram describing automatic features (triggered by time).

According to the adopted methodology this stage ends after discussion with all stakeholders. The work will proceed with the modelling of the static perspective of the system using the class diagrams.

In point 5, fictional scenarios and their discussion of the expected impact are presented.

5. Fictional scenarios and expected impact

Two fictional scenarios with older person's users were conceived for assessing the expected impact of the design and implementation of HelpWave: scenario 1, user in holiday, out of his home village and scenario 2, user at his home village.

5.1. Context - "Catching the wave"

Manuel and João are smartphone users that, at a given time, joined the HelpWave system by installing the HelpWave APP in their smartphone. They setup HelpWave to report time usage of Facebook and Calls, and they already use two APPs compatible with HelpWave, Compass & Magnifier (C&M) [16] used to promote their confidence in daily mobility and HelpmePills [17] for assisting pills intake. Note that both APPs are under construction and are referred to corroborate the presented concepts.

5.2. Scenario 1 – In holidays

Manuel joined the "HelpWave" after knowing that a friend volunteered to help others like him, who sometimes gets disoriented and feels little confident to leave the house.

He is preparing to spend holidays outside his neighbourhood. He doesn't feel confident to walk alone given the lack of proximity of known places and known people that could help in case of need.

Arriving at the hotel he asks the receptionist for help, *i.e.* to enter "the wave" and accept the task to take care of him during his afternoon walk. In addition, as he usually forgets to take his medications, he also asks for help for remember his pills – grant permission to access his intake pills status and pills schedule.

Later, it came to his knowledge that some other hotel-clients were volunteers in the "Wave" and they were in the same beach by then! Thus, Manuel decided to change its status to "accept aid on the beach" and also to provide assistance to those who may need it, like himself.

5.3. Scenario 2 – At home village

Mr. João lives alone in a remote village and he is taking an important medicine that enables him to live a normal life. His children live outside the village and are always concerned about helping him in case of need.

Since they discovered that some of his father's neighbours have also "entered the wave", they joined and convinced him to join as well.

In fact, since the local community centre joined this initiative, many people of the region have also joined. They heard that they could help and be helped by others whether or not members of that institution and without having to pay.

5.4. Discussion

In scenario 1, it can be expected benefits for carereceiver (Manuel): a) confident to ask for help during his walks – HelpWave enable the task to be done remotely through smartphone or PC, therefore smaller favour to ask; b) filling of safety – knowing that in case of need caregiver (receptionist) will notice and trigger help; c) opportunity to help others and be helped *i.e.* social interaction between pairs. From the point of view of caregiver - hotel receptionist the improve safety and satisfaction of their costumers can be of a great benefit.

In scenario 2, carereceiver (João) can expect benefits: a) combining the proximity help of neighbours and community centre with the care of his children making him feel much confident, maintaining his daily routines; b) sense of usefulness for having the opportunity to help others like him and his friend and neighbour; c) enabling participation in community initiatives *e.g.* for social interaction.

His children benefits: a) more confidence and awareness of any relevant occurrence about their father's health evolution, long distance monitoring; b) easier contact to someone near for direct assistance.

The communal centre benefits: a) a tool to promote or improve the quality of home or telecare systems and social interaction among their clients/ residents.

5.5. General concepts discussion

With this HelpWave idea, instead of creating another application dedicated to "help" old people, we advocate an inclusive and intergenerational social network perspective. The concept of a "wave" relates to the motivation for participation in a communal initiative, sharing problems and solutions. By another hand, one may consider the possibility of a person liking to be identified and socialize with other "volunteers" – other people that may share some of values and feelings.

The sense of usefulness and personal engagement of a volunteered action of help, may also be stimulated by the idea of an opportunity of being helped at a certain time by another person.

Nonetheless, one may also consider the possibility of being identified and socialize with other "volunteers" – other people that may share some of values and feelings.

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