Application of a Comprehensive and Extendable Package of Personalizable Digital Services in Supporting Healthy Ageing

Marcin Adamski[1], Maciej Bogdański[2], Mikołaj Buchwald[2], Ludo Cuypers[3], Kinga Ćwiklińska[2], Michał Kosiedowski[2(✉)], Marcin Wieczorek[2], and Sergiusz Zieliński[2]

[1] Grinfinity Sp. z o.o., Pl. Wladyslawa Andersa 7, 61-894 Poznan, Poland
[2] Poznan Supercomputing and Networking Center, ul. Jana Pawla II 10, 61-139 Poznan, Poland
kat@man.poznan.pl
[3] Commeto Bvba, Veldhovenstraat 40, 3945 Ham, Belgium

Abstract. It is by now a long-established fact that the European population is ageing. While this trend results largely from positive phenomena, it does come with a set of societal challenges. One of these challenges is making sure that the quality of life experienced by the growing population of elderly citizens remains as high as possible. The PELOSHA project aims to tackle this challenge by developing a comprehensive, personalizable and extensible solution aiding the wellbeing and remote care of older adults. The solution consists of a set of tools targeting various areas of the senior's wellbeing, orchestrated by unified mobile applications dedicated for end users. Work performed on the solution included user involvement every step of the way. The design and development of the platform and its user interface take into account the user needs obtained via interviews. The resulting system undergoes validation in a series of pilot deployments in 3 countries.

Keywords: Seniors · Ageing · AAL · Wellbeing · Package

1 Introduction

PELOSHA is a comprehensive solution aiding the wellbeing and remote care of older adults. The solution consists of a set of tools targeting various areas of the senior's wellbeing, orchestrated by unified mobile applications dedicated for end users.

The main target group for PELOSHA are seniors in assisted living facilities and their caregivers. The seniors start out with different sets of services depending on their age and condition. Afterwards, they continue to utilise the system while aging and the set of services evolves according to their changing needs, from preserving a good quality of life to managing the difficulties that will arise with the passing of time. The marketing claim of the PELOSHA platform focuses on the positive ways it influences the life of the user - "Assist me in living an active and happy life".

This paper describes the problem background, the idea behind the PELOSHA project, as well as the design of the technological platform.

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2 Problem Background

It is by now a long-established fact that the European population is ageing. Data by Eurostat from 2020 [1] shows that older people, defined as those aged 65 or more, made up 20.3% of the EU population in 2019. This ratio is projected to increase to 29.4% by 2050, and within this group, a growing part will be the people aged 75 or more. Furthermore, it is important to note that the old-age dependency ratio for the EU-27 was 25.9% in 2001, 34.1% in 2019, and is projected to reach 56.7% by 2050, meaning there will be fewer than two persons of working age for each older person (aged 65 or more). One of the challenges that arise from this trend is making sure that the quality of life experienced by the growing population of elderly citizens remains as high as possible.

A very promising route that is being explored in order to tackle this challenge is the usage of ICT technologies for alleviating the impacts of adverse symptoms related to ageing. Contrary to popular belief, low uptake of modern technology by seniors might not be a big barrier for this application. Our experience from the AAL Fit4Work project [2] has shown that seniors, at least the ones in the Exit phase of their life (so still professionally active), are willing to use ICT-based services, especially ones that offer support for their health and wellbeing. Eurostat's data on information and communication technologies (ICTs) [3] shows that in 2014 more than one third (38%) of the elderly population in the EU used the internet on a regular basis, which means there were at this time around 36.5 million elderly people in the EU who used the Internet on a regular basis and this number is bound to increase.

3 Proposed Solution

PELOSHA is a comprehensive solution aiding the wellbeing and remote care of older adults. The solution consists of a set of tools targeting various areas of the senior's wellbeing, orchestrated by unified mobile applications dedicated for end users.

The technologies and devices comprising the base of the various PELOSHA services are organised into independent modules. A module is a logical entity able to provide recommendations based on the operation of dedicated hardware (sensors) and software (rules for interpreting the measurements from the sensors). Therefore, from the point of view of the whole platform, a module is an autonomous unit capable of providing a specific recommendation-based service.

The general concept of the PELOSHA platform from the senior's point of view is presented in Fig. 1. The utilization of PELOSHA services is managed by the PELOSHA Assistant – an intermediary component between the user and the different modules integrated within the PELOSHA platform. The Assistant initially determines the general needs of the user based on their age, a set of preliminary measurements from the available sensors and/or a simple questionnaire. Afterwards, the Assistant queries the available PELOSHA modules about the current status of the user and their surroundings. Upon receiving an answer that is unsatisfactory in the context of the previously established personalized goals, the Assistant sends a follow-up request to the module, asking for recommendations for the user. The Assistant is also able to ask the modules for more specific data or to request that they perform a specific function (e.g. display guidance for an exercise).

The modules, on the other hand, initiate communication with the Assistant whenever the need to send a recommendation arises, e.g. a measured value exceeds a certain threshold. It is the Assistant's role to decide which recommendations obtained from the modules should be presented to the user as a notification, as well as how to combine the data received from different modules. The purpose of the Assistant is to provide the user with a single entry point to the modular PELOSHA services that assists them in maintaining a healthy, active and happy lifestyle in a seamless and proactive way.

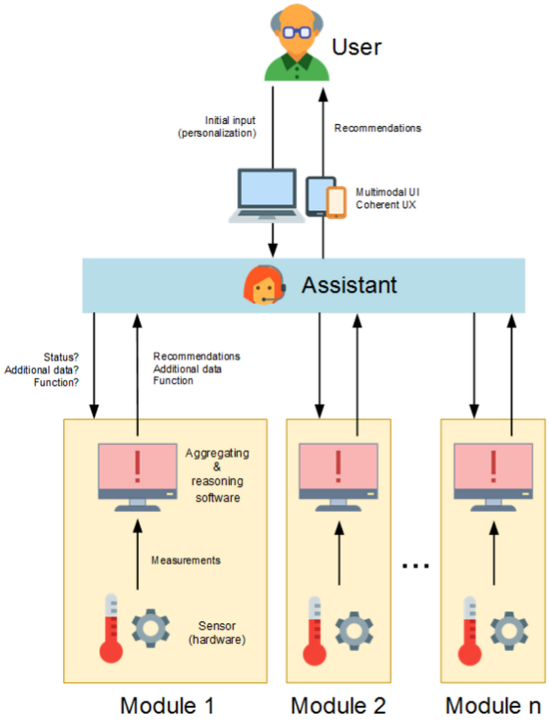

Fig. 1. Generic diagram of the PELOSHA platform from a senior's point of view

The caregivers interact with the different PELOSHA modules using the Caregiver Dashboard. The Dashboard presents the caregiver with aggregated data concerning all their charges. They are also able to view detailed data gathered for a specific person. The caregiver receives a notification in the Dashboard when an event requiring their attention occurs, e.g. a measured value exceeds a certain threshold. Thanks to the Caregiver Dashboard, caregivers are able to keep better track of their charges, without getting overwhelmed by the amount of gathered information.

The platform takes advantage of the synergy between the integrated solutions due to a novel combination of both: the capabilities provided by individual modules, and a set of crucial characteristics of the platform. Some of those characteristics are unique to PELOSHA, while others can be found in other AAL solutions targeted at tackling

the challenge of supporting healthy ageing by providing a package of integrated services, such as DAPAS [4], INCARE [5], LIFANA [6], POSTHCARD [7], vINCI [8], or VITAAL [9].

In particular, the PELOSHA solution combines the following characteristics:

- comprehensiveness,
- uniformity of user experience,
- connectedness - data coming from different modules is analysed in parallel,
- sharing of devices between modules,
- flexibility - the system evolves with the needs of users as they age,
- extensibility - possibility to add new modules providing additional services,
- dedication to the specific user group,
- customizability - users select the modules and devices matching their needs/budget,
- personalizability - recommendations provided to the end user are influenced by analysis of previously gathered data.

4 Integrated Services

In the beginning of the project, a set of questionnaires were created and used to conduct semi-structured interviews with the seniors as well as their formal and informal caregivers, meant to elicit their ideas and requirements pertaining to the functionality of the PELOSHA system. This allowed to identify the areas of specific interest for the end user base among the initial ideas prepared by the project consortium. This set of areas of interest, confronted with such factors as the capabilities of the consortium, scope of the project, or legal considerations, served as a base for the initial list of functionalities that the prepared solution should provide.

This means that the decision was made that some of the user needs expressed during the interviews will not be met by the initial set of services integrated with the system. Examples of such needs are fall detection (due to a lack of existing solutions possible to integrate at the time of making the research) or panic button (because integration with existing systems would void their certification). However, the extensibility characteristic of the PELOSHA mentioned before means that those services can be integrated into the platform at a later time, when e.g. a fall detection solution maker is interested in making it available through PELOSHA.

As a result, the modules currently integrated into the PELOSHA platform include:

Health - allows to collect data on seniors' health (e.g. blood pressure, weight, body temperature), and provides access to this data for the caregivers. This helps maintain the continuity of care and improves the peace of mind of both the senior and the caregiver.

Reminders - gives caregivers the ability to add any event (e.g. reminder to perform a measurement) to the senior's calendar. The senior then receives a notification on the event at the specified time, allowing them to keep track wellbeing-related calendar.

Night Activity - the module collects electrical data from the distribution board via current transformers on each phase wire. The data is then analysed in order to determine

which appliances have been active at what times. Finally, the data is transformed into human night-time activity patterns, which can be useful for detecting early symptoms of cognitive impairment (sundown syndrome).

Air Quality - the module monitors the state of the environment and recommends the appropriate actions to the user. This improves the indoor air quality, which results in better health conditions for the user. For outdoor air quality, recommendations about good and bad times for going out can be given.

Training - the general concept of the module is similar to a virtual personal trainer, with visualisation of an animated 3D trainer character and several virtual training spaces. The user appears in the virtual room as a stylized avatar following the user's movements thanks to full body motion capture. After an exercise set, the module evaluates the user's movements and performance, and a report is generated on the accuracy with which the user was following the instructions of the virtual trainer.

Activity - the module uses data gathered with the use of a smartband to provide a measure of physical activity of the user, including information on the type of user's movement, on the overall intensity of actions performed by the user during a given day, and on meeting the daily activity goal that is defined by the users themselves, given their BMI.

Staying in Touch - the module is created in order for an elderly person's needs to be automated logistically. It gives a possibility to ask for help with a help button. This button redirects to friends, family and professional caregivers, allowing the senior to signal their need of help in practical issues and improving their mental state by providing the feeling of safety.

5 Final Remarks

In this paper we discussed the construction of the PELOSHA platform. This platform is the approach of the project consortium at contributing to the increasing challenge of supporting good quality of life of the growing European population of seniors. The PELOSHA platform, while having its own vision of enabling a future marketable, extensible and customizable AAL solution, implements several features common to other solutions in the area that have been already developed or are currently under development. These include e.g. the comprehensiveness, connectedness, flexibility and personalizability of the platform. It must be noted that the PELOSHA solution has been extensively based in the identified needs of the target end users and the process leading to the creation of the platform prototype was characterized by a high degree of user inclusion, in order to increase the certainty concerning its usefulness.

As we have reached the moment in which the project has been able to successfully develop the envisaged prototype of the platform, end users will remain at the centre of our attention in the next step. This relates particularly to the already ongoing phase of pilot testing of the created solution. The developed platform undergoes testing in a

pilot deployment in 3 countries, meant to validate its operation and, most importantly, confirm the correctness of the elected approach to the idea of integrating AAL services and offering them to the end users. This testing phase should enable us to deliver the final porotype of the developed platform at the end of the project. This prototype, in our opinion, constitutes the basis of providing a minimum viable product (MVP). This MVP could get extended in the future with further functionalities that were not included during the project, but might carry a potential of increased value to the target users and/or customers. Potential examples of such extensions include modules providing new services, like fall detection, or further development of the capabilities of the Assistant module, allowing it to make an even bigger use of the data coming from different sources in order to provide ever more informed recommendations. Adding such extensions should however, follow the first practical deployments of the developed solution.

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