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<tr>
<td><strong>Author(s):</strong></td>
<td>Javier Solana, Hermie Hermens, Francisco Garate, Elena Hernando, Enrique Gomez</td>
</tr>
<tr>
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**Abstract:**

This deliverable tries to give a general overview of the current status of the progress done in every work package after the second year of the project. The main objective is to provide a visual picture of the PERSSILAA services and studies already carried out, through a set of posters that have been created by each task’s responsible. These posters not only contribute for enhancing the visibility of the project results to the different communities, but also will help the reviewers to better understand what will be shown at the second year review of December 2015, where the current status of the platform, its provided services, and research and validation studies will be presented.

**Keyword list:**

demo, services, dissemination, studies, posters
## Document History

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1 Executive Summary

The “PERsonalised ICT Supported Services for Independent Living and Active Ageing” project, also called PERSSILAA, is a FP7 funded European project. It combines a consortium of eight partners from five countries from social, medical and technological sciences with industry, academia and end user organisations. This consortium aims to develop an information and communications technology (ICT) platform to identify and manage community dwelling older adults at the risk of functional decline and frailty. It develops and validates a new service model, comprising a screening module, based on screening methods that are easily carried out and give an overall picture of a person’s health; an unobtrusive monitoring module of everyday functioning and a training module containing remotely available health promotion programs. With this approach PERSSILAA adheres the tenants of the European Innovation Partnership on Active and Healthy Aging (EIP on AHA) to increase the healthy life span in community dwelling older adults.

This document reviews, by a set of created posters, the progress done so far for each of the main tasks defined in PERSSILAA. The posters that the reader will find below have been selected to illustrate, on a visual way, the main achievements obtained by the consortium so far, from the service model definition, domain-specific modules, more technical, research studies to the description of the two pilot sites and exploitation models.

2 About this document

2.1 Role of the deliverable

The main role of this deliverable D6.4.2 is to summarize the main achievements of PERSSILAA after the second year of the project. In order to do that, all the partners of the consortium have worked together to create a set of posters, visually reflecting the main concepts, definitions, designs, modules, and studies which have been already carried out.

Actually, a live demo at the second-year review meeting will be part of this deliverable too. This document aims at anticipating it tough, giving the reviewers an idea of what will be presented at the meeting.

2.2 Relationships to other PERSSILAA deliverables

After the first year of the project, the first version of this deliverable (D6.4.1) consisted of a video showing the ideas and concepts of the PERSSILAA project. Following this, D6.4.2 collects and summarizes the work done in all the other work packages after the second year of the project, so it is closely related to those deliverables that have been already submitted until the date, but also to other ones that will be submitted within next year.

The following list tries to summarise those deliverables which mainly fed D6.4.2:

- D2.1 Shared vision on screening and prevention of frailty
- D2.2.1/D2.2.2 Service scenarios, Use cases and functional specification (initial and updated)
- D2.3.1/D2.3.2 Technical requirements and service architecture (initial and updated)
- D5.1 Service protocols
- D4.1 Procedures and technical specifications for interoperability
- D5.2 Validation design and METC approval
- D6.6.1/D6.6.2 Exploitation strategy (initial and updated)
- D3.1 Screening methods and anticipatory triage protocol
2.3 Structure of this document

The document starts with an introduction of each poster presented in this deliverable, followed by the Power Point posters themselves. In total, 14 posters have been created, each one showing relevant work achieved so far related to the most important tasks of the PERSSILAA project.

3 Demo posters

The posters that the reader will find in the next pages are introduced in this section, which are designed in such a way that they can also suffice as stand-alone dissemination material. This explains why many of the poster introductions have quite some overlap.

The first three posters deal with all the general aspects and concepts of the project, such as the technical platform supporting the services, and the service model itself.

1. “PERSSILAA: supporting healthy ageing”
   This poster tries to reflect the main concepts and ideas which have been defined within the project, and which have guided all the other activities during these two years of the project. It gives a general overview of the services provided by the PERSSILAA platform.

2. “ICT platform: architecture and functional blocks”
   This poster describes the ICT architecture that has been developed to provide the services defined in the project. It mainly describes every building-block (module) that build up this architecture, illustrating the relations between them.

3. “The service model”
   This poster shows the ideal service model defined for PERSSILAA, illustrating the two-phase screening method aiming at classifying older adults into robust, frail and pre-frail, the latter of which being selected to participate in the training program.

Then, the next posters address the description of the different services defined in PERSSILAA, for screening, monitoring and training the older adults.

4. “Screening procedure & content”
   The screening procedure is one of the main pillars of this project, and this poster illustrates in what way it has been implemented in The Netherlands, describing how the 1st and 2nd screening are administered to users trying to get a picture of the health status of a person.

5. “The monitoring module”
   This poster describes the monitoring module, which provides a detailed insight in daily functioning without a need of face-to-face contact with volunteers or healthcare professional. Relevant variables from the three domains (cognitive, physical and nutrition) are monitored for every user.
6. “The physical module”
This is the first of the three posters covering the training modules integrated in PERSSILAA. The physical module one describes the web-based exercise program that focuses on physical functioning and supports older adults to perform the right exercises in a proper but independently and safe manner in their home environment.

7. “The cognitive module”
The module for training the cognitive domain is described with this poster, consisting of a set of computerized tasks or game-based exercises that let the older adults to train attention, memory or executive functions.

8. “The nutrition module”
The last training module is related to the nutrition domain, addressing the description of the educational website created for the PERSSILAA project. On this website the user can find recipes, videos, advises and information about healthy eating or how to build their own vegetable gardens. All the different modules are described in this poster.

The next three posters cover those tasks that can be considered more research works, such as the gamification layer and the intelligent core. The reader must take into account that the project focuses on developing an efficient, reliable and easy to use platform for end users. Therefore, the technical services work on gamification, interoperability and clinical decision support systems.

9. “Effective gamification for older adult users”
This poster describes the studies carried out in order to develop suitable, effective gamification for the particular context of the PERSSILAA project. The main goal of these studies was to gain insight in the state of the art of gamification as a motivational strategy and on the possibilities of tailoring content to create a personalised experience for the user.

10. “Gamification concepts and realization”
This poster follows the previous one, taking into account the study results on the game preferences of the older adult user, describing the way that the gamification layer focuses on the reinforcement of engagement through meaningful interaction.

11. “Intelligent core”
This posters tries to give an overview about the intelligent core that has been defined for providing to PERSSILAA with a layer that allows to perform advance analysis and processing of the data gathered from all the different modules (screening, monitoring and training). The main objective is to automatically detect changes and behaviour and do proper personalized suggestions, by comparing results of users that have similar characteristics and necessities.

The next two posters address the description of the two pilots sites within PERSSILAA, the Dutch one and the Italian one:

12. “Dutch pilot site – study setup”
This poster describes the objective of the Dutch pilot site evaluation study, which is to investigate the user satisfaction, use, effectiveness and economic outcomes of the PERSSILAA platform for older adults.

13. “Italian pilot site – study setup”
On the other hand, this poster covers the Italian pilot site, where PERSSILAA aims at developing a new health service for detecting and preventing frailty among older adults that uses innovative eHealth service with a strong basis in their local communities.
The last poster is related to the exploitation of the results achieved in PERSSILAA.

14. "Exploitation of PERSSILAA"
   This poster illustrates the exploitation strategy followed within the project, which will enable to build business cases for commercial exploitation, to create a living framework of exploitation methods, and to do research into exploitation of telemedicine applications.
3.1 PERSSILAA ideas and concepts

PERSSILAA
Supporting healthy ageing

Miriam Vollenbroek-Hutten
University Twente, Telemedicine group,
Enschede, The Netherlands

Hermie Hermens (RRD), Maddalena Illario (FOUND),
Amelia Rauter (FFCUL), William Molloy (UCC), Enrique Gomez
(UPM), Rocío Sanchez (FPING), Mario Scherillo (Nexera)

Introduction
In the European Union, the number of people aged 65+ will almost double over the next 50 years. Among older adults, frailty is highly prevalent and constitutes a major health problem. People affected by frailty make the most use of community resources, hospitals and long-term care institutions. PERSSILAA (www.perssilaa.eu) is an European project that develops and validates a new service model, to screen for and prevent frailty in community dwelling older adults.

Methods
PERSSILAA’s research and activities focus on three areas (Figure 1):

- **Service modules** for screening, monitoring and training in the cognitive, physical domain and on nutrition.
- **Service modules** that organize care into preventive personalized services offered through local community services, supported by a proactive team of caregivers and health professionals and integrated into existing healthcare services.
- **Technical service infrastructure** to support these multiple services and users in an efficient, reliable, easy to use way. PERSSILAA therefore works on gamification, interoperability and clinical decision support.

PERSSILAA works via an iterative process for development, implementation and evaluation involving at least 350 end users in **two reference sites** being Enschede, The Netherlands and Campania region, Italy.

Results and Future Work

PERSSILAA so far realized:

- **Service models** for the two validation sites
- An **integrated platform with service modules** that enable screening on being frail, showing decreased functioning or being robust and training of cognitive and physical functioning or information about healthy nutrition.
- First implementation and evaluation cycle with end users for the integrated platform with the screening and physical trainings module at both validation sites
- First **prototypes** of the monitoring module, gamification layer and intelligent core.

![PERSSILAA Concept Diagram](image)
3.2 PERSISILAA platform: architecture and functional blocks

Introduction

In order to set the proper environment for the provision of the services defined in PERSISILAA, an ICT building-blocks architecture has been defined. The process of building-blocks definition takes place gradually, as an iterative process, adapting to detailed information about the functionalities, possible constraints imposed on the architecture or modifications on the user needs. The building blocks are the main goals that need to be identified. Then, along the lifetime of the project, they have been iteratively redefined to accomplish the user needs.

The building-blocks architecture

End user: the user roles defined in the project, representing the different kind of users who are accessing the services provided by PERSISILAA: older adults (~65 years), professionals (mainly General Practitioners), researchers (analyzing data), volunteers (helping older adults), office coordinators (managing users) and administrators (managing the web platform and modules).

User interface (Personalization): depending on these user roles, the personalization layer will offer the corresponding services.

Privacy and security: ensuring the privacy and security of the information stored in the system, letting users accessing only the information that they are allowed to. This module is based on three main concepts: integrity, availability, and authenticity of the data.

Interoperability & HIE: in charge of building the architectures that will be used for the exchange of information, ensuring semantic interoperability between different parts (based on the CEN/ISO EN 13606 standard).[5]

Screening modules: assessing the frailty status of the elderly, developing an easy to use multidimensional screening tool integrating different domains.

Training modules: integrating the different service modules used for training the three different domains: nutritional (Nutrigenetic website), physical (CoCo), and cognitive (GNPT).

Monitoring: managing the network of sensors used for monitoring the daily physical activity of the elderly, such as Fitbit devices and Withings Smart Body Analyzers. Furthermore, the monitoring module is responsible for managing the information regarding the monitoring of the elderly’s daily function (e.g., routines). A set of questionnaires, similar to those used for the screening, have been also defined, for monitoring the cognitive, nutritional, and physical functioning of the user every three months.

Classification layer: covers all modules with close connection to the GUI and/or in the sense of details connecting underlying training modules and exercises in a playful manner: enhancing engagement and creating better adherence of the user to the exercises.

Communication device: development of a set of libraries to implement the ISO/IEEE 13606 making interoperable the communication between devices and the system. This set will allow to easily integrating each possible sensor that implements this family of standards.

Intelligent core: analyzing all the data stored in the system (screening, training and monitoring modules) to extract knowledge by applying data mining techniques. Then, pattern recognition will be used to classify the user into profiles, so prediction of healthy risks and personalized advice in daily activities can be done, with the final goal of generating automatic feedback to the user. This module will manage a separate database specifically designed for knowledge extraction, in order to not overload the main clinical database.

Conclusion and Future Work

The architecture defined in PERSISILAA consists of a set of building blocks depicted in an architectural model, together with a specification of how these building blocks are connected to meet the overall requirements of the system. After the second year of the project, the building blocks architecture can be considered as closed. However, we will keep evolving it adapting to the new necessities or changes required by final users.

References

3.3 Service model

The service model

Lex van Velsen
Roessingh Research and Development,
Telemedicine group, Enschede, The Netherlands

Minam Vollenbroek-Hutten (UT)
Stephanie Jansen-Kosterink (RRD)
Maddalena Illario, Catherine Crola,
Caroline do Somma and Anna Maria Colao (FOUND)
Javier Solana (UPM)

Introduction

A community-based, technology-supported service model for screening for frailty among older adults and training their health can be a cost-effective alternative for the clinic-based services that are currently available. In PERSILAA, we developed such a service model by means of participatory design with stakeholders (e.g., local government, Municipal Health Services, General Practitioners) and end users (older adults). A full discussion of how this development took place can be found in [1].

Development and Results

During the first participatory design sessions, we worked towards an ‘ideal’ Pan-European service model. In subsequent meetings with stakeholders, we took this ideal and refined it so that it would fit with the Dutch and Italian context. As such, the ideal is a very suitable base for developing a regional service model, but should always be verified and/or adapted for the context of use.

Two important starting points for developing this service model that arose from the participatory design sessions are:

1. The older adult is the main responsible person for the management of his or her health;
2. General Practitioners want to be informed about screening results, but should not be provided with additional work. Activities deployed within the context of PERSILAA should be integrated as much as possible with the daily routine of their practice.

The ideal service model served as the basis for developing non-functional specifications for an online PERSILAA portal.

Conclusion and Future Work

The service model that we have developed marks a step forward in creating healthcare services for older adults that not only include care by professional caregivers to deal with acute problems, but also lead to a set of healthcare services that prevent problems by integrating initiatives in the community with online services.

Our next step is to validate the service model with stakeholders and end-users. Therefore, we have created short animations that show how the service goes about. Our target group will be shown this animation in an online environment and will subsequently be questioned about the service’s usefulness, strong and weak points, and their acceptance of it.

References

3.4 Screening procedure

Screening procedure and content

Sanne Frazer and Stephanie Jansen-Kosterink
Roesingh Research and Development, Telemedicine group, Enschede, The Netherlands

Introductions

Early screening on risk on frailty and functional decline is the key to successful prevention and can take advantage from technology-supported health services to foster empowerment and self-care. This European project, PERSILIA, a community-based, technology-supported health service is developed to screen older adult and prevent frailty, where care and welfare organizations work together to screen their older adults. The screening procedure has been designed on such a way that could be used throughout Europe, being also flexible enough to allow adaptations to the specific context appearing in the country where it is implemented.

Methods - Screening procedure

The screening of the PERSILIA project is twofold: 1. A first screening on paper or online and 2. A second face-to-face screening, only for the pre-frail older adults.

Methods - Content First Screening

The GFI, SF-12, IME-SA, Katz ADL, MNA-SF, SF-36 physical functioning and some general questions are asked to the older adults to screen for frailty during the first screening procedure. After the first round of the screening held in 2014, the content used for the screening has been evaluated and improved. The cognitive assessment used in 2014 was based on a self-rated level and it was found out that it was not good enough for classifying people. Therefore, the AD8 dementia screening has been added [2]. Because of the extensive length of the overall questionnaire, two questionnaires without added value were removed, namely the IME-SA and Katz-ADL.

Methods - Content Second Screening

The second screening is meant to identify, in more detail, the problems (physical, cognitive, and nutritional) of the pre-frail individuals coming from the first step of screening (self-screening). At the same time it may identify frail individuals who were not detected in the first level screening or detect individuals who were classified as pre-frail in the first screening. This second screening consists of four objective physical tests (Timed-Up-and-Go, Chair-stand test, Chair-6-seat and Reach test and Two-minute step test), a cognitive test (MMSE) and a nutrition questionnaire (MNA-SF).

Results & Future work

In September 2014 a first screening was executed in the municipality of Enschede, neighborhood Stadshuizen. The screening questionnaire was sent out to 1253 older adults, 556 older adults who completed the questionnaire gave permission to use their data for research purposes. Based on the scores of the questionnaire, 25.2% were classified as frail, 22.8% as pre-frail and 52.0% as robust. In total 128 pre-frail older adults were invited for the second screening. Of this pre-frail group 64.5% had a functional decline on cognition, 52.5% on physical functioning and 11.5% showed functional decline on nutrition. In September 2015 the screening questionnaire was sent out to 1253 older adults in the municipality of Enschede and to 3725 older adults in other municipalities in the region of Enschede. The screening procedure will be repeated in the third year of the project in multiple municipalities in the region of Enschede. To optimize the content of the screening, the outcome of the first and second screening will be assessed.

References

3.5 The Monitoring Module

The monitoring module

Miriam Cabrita  
Roessingh Research and Development,  
Telemedicine group, Enschede, The Netherlands

Paco Gárate (UPM), Alejandro García (FPIING)  
Helena Soares Costa (FFCUL), Rónán O’Coain (UCC)  
Hossein Nassab (UT), Maddalena Illano (FOUND)

Aim

In line with the ambition of PERSILAA to improve healthy aging by supporting self-management of older adults, the monitoring module provides a detailed insight in daily functioning without a need of face-to-face contact with volunteers or healthcare professional. Its role is to facilitate early detection of functional decline and trigger alerts whenever necessary. In addition, the data collected can be used to enable personalized interventions for frailty prevention.

Concept

The monitoring module consists of a set of tools chosen to monitor physical-, cognitive- and nutritional functioning in daily life. To this set of tools we call sensing block (blue block in Figure 1). Data is collected through wearable sensors (physical activity), home sensors (body weight and BMI), the mobile phone (daily wellbeing) and the web portal (cognitive performance and eating habits).

Additionally, in order to improve the overview of the daily functioning of the older adults, relevant data is gathered from the screening and the training modules:

- **Screening module**: results of yearly and 3-monthly assessments of the health status of the elderly through validated questionnaires on the PERSILAA portal;
- **Training module**: performance (e.g., current level) and interaction (e.g., frequency of training) outcomes within each training service.

The **monitoring layer** is therefore a service layer which consists primarily of a database that aggregates and stores all the data from the sources aforementioned (Figure 1).

![Diagram of monitoring layer](image)

**Figure 1.** Monitoring layer consisting of data collected from three sources: the screening module, the training services and the sensing block. The dashed lines represent the way of interaction with the user and the white blocks the parameters assessed.

Next steps

A first prototype of the monitoring module has been developed and currently a proof of concept study is being developed that focus on usability and feasibility aspects. Future work includes development and improvement of feedback mechanisms to the user and integration with the Intelligent core and the gamification layer of PERSILAA (WP4).
3.6 Physical Module

The physical module

Marit Dekker-van Weering
Rozessingh Research and Development,
Telemecine group, Enschede, The Netherlands

Sanne Frazer and Stephanie Jansen-Kostornik (RRD)
Maddalena Illiano (FOUND)

Introduction
Exercise interventions may be effective in preventing, delaying, or reversing the frailty process. As such, exercise programs have important benefits for older adults, health services and society. The objective in the PERSILAA project is to develop, implement and validate a web-based exercise program that focuses on physical functioning and supports older adults to perform the right exercises in a proper but independently and safe manner in their home environment.

Development
An existing physical exercise platform has been used as a starting point to define the requirements for the PERSILAA physical module. A user centred design approach was used, in which both older adults and physiotherapists participated. Different workshops with end-users were held and questionnaires have been filled in. The program has been validated with physiotherapists and a usability and pilot-effect study has been performed among older adults in the Netherlands.

The physical module
The physical module is based on the evidence-based Otage home exercise program [1]. The program consists of two modules: (1) training and (2) monitoring.

Training module
The training module consists of 3 months home-based exercising and provides a 30 minute workout with strength, balance and flexibility exercises and progresses in four levels. Video and voice overs guide the user through the exercises (see figure 1). The training can be performed in the home setting or at a PERSILAA point in the neighborhood.

Monitoring module
Different monitoring options are included in the service, which gives information to the therapist about the performance of the older adult in the training program.

Results
Sixteen older adults participated in the intervention group and usability in this group was high (mean System Usability Score 4.3). They trained on average 2.8 times a week with a mean duration of 24 minutes each time. Older adults preferred to train in the morning and afternoon and during weekdays. Three older adults visited the PERSILAA point weekly.

The intervention group (n=16) scored significantly higher on Health Status (EQ-5D Index; see figure 2) and the Mental Component Score of the SF-12 compared to the control group (n=21).

Future work
• New requirements for the physical module are gathered during the past year and will be updated in a new version by the end of this year.
• A recommender system will be developed that suggests the most critically relevant exercises while considering user preferences and feedback.

References
3.7 Cognitive module

The cognitive module

Rocio Sanchez Carrion and Alejandro Garcia
Fundació Privada Institut de Neurorehabilitación Guttmann,
Badalona, Spain

Introduction
Age-related decline in cognitive functions can be delayed with training interventions by means of the execution of cognitive tasks. Attention, memory and executive functions are the main cognitive functions having higher impact in activities of daily living (ADLs). An aged brain has the capacity to change in response to stimulation. A cognitive training self-management algorithm is designed, implemented and validated.

Methods

Training algorithm: 35 cognitive tasks are distributed in two blocks, B1 and B2, to be executed in a specific order (Figure 1). B1 tasks are evaluation oriented, B2 tasks are training oriented. After each task execution the user obtains a score between 0 and 100 (70-100).

Results in Therapeutic Range (TR = [65,85]) are defined as those not too easy or too difficult for user to execute.

User executes B2 tasks iteratively, the algorithm increases or decreases tasks’ difficulty level in order to obtain results in TR.

B1 is composed of 10 tasks: Attention (5), Memory (3), Executive functions (2). The difficulty level of each task is fixed.

B2 is composed of 25 tasks: Attention (9), Memory (10), Executive functions (4), Orientation (2), Arithmetic (2), Perception (1). Four difficulty levels.

Total Training: 12 weeks, 3 sessions per week, one hour per session. In total, 36 sessions.

Results and Future Work

Dutch usability testing (n=8) Average grade= 6.4/10.
SUS = 56/100 (System Usability Scale)

Dutch training (n=15) Total number of sessions: 103.
Total number of tasks executions 753 (Figure 2): Attention (229), Memory (322), Executive functions (120), Arithmetic and Perception (87) Total number of tasks executions in TR 168: Attention (37), Memory (103), Executive functions (18), Arithmetic and Perception (10). TR tasks executions: 23% of total executed tasks.

Italian usability testing and training. Actually being performed in Campania Region.
3.8 Nutrition module

The nutrition module

Marta Sousa Silva and Tânia Gonçalves Albuquerque
Faculdade de Ciências, Universidade de Lisboa,
Lisbon, Portugal

Introduction
Nutrition education strongly contributes to healthy eating practices, improving nutritional status and decreasing the rate of functional decline with age. NUTRIAGEING (nutriageing.fc.ul.pt) is an interactive website providing nutrition literacy by an original and enjoyable set of tools encouraging the adoption of healthy food habits [1]. It was created for the transfer of scientific knowledge into advice to the general public, offering several modules to educate the elderly about relevant topics, e.g., antioxidants, metals in food, vitamins, functional ingredients and supplements [2,3]. It also gives users the opportunity to test acquired concepts with crosswords and quizzes in the enjoy section. The website is structured around healthy eating, cooking recipes and videos, and how to grow recipe ingredients in vegetable gardens [4].

Methods
Nutriageing is an informative website with a very clean, easy-to-use, “app-like” interface. It conforms to HTML5 and embeds the popular framework Twitter Bootstrap 3 which provides a mobile-first grid system to create a responsive layout, automatically adapting to different devices. Furthermore, the semantic structure of the code respects accessibility guidelines of web development.

The back-end is supported by a classical combination of Apache, PHP and MySQL. It is hosted by the FFCUL IT infrastructure. Most of the back-end functionality relies on a Content Managing System (Wordpress) and its plug-ins.

Results

Healthy eating

Vegetable gardens

References
3.9 Gamification studies

Effective gamification for older adult users
Increasing adherence in game-based telemedicine solutions

Frederiek de Vette
University Twente, Telemedicine group,
Enschede, The Netherlands

Hermie Hermens (RRD)
Miriam Vollenbroek (UT)

Introduction
In PERSILAA, we use gamification to create a motivating experience from the engagement of games in an existing interaction. The activity of a user on the screening, monitoring and training modules is reflected through game progression. In order to develop suitable, effective gamification for this particular context, a series of studies was conducted to gain insight in the state of the art of gamification as a motivational strategy and on the possibilities of tailoring content to create a personalised experience for the user. Our most important findings are synthesised on this poster.

Study results

[1] Engaging elderly people in telemedicine through gamification
Gamification may be a suitable strategy to increase adherence to telemedicine applications but a lack of a refined conceptualisation of this strategy exists in these disciplines and gamification, for elderly people in particular. In this study we explored existing user classification theories that may serve to the tailoring of game content to the target user. Several approaches for classifying users in general were found, based on archetypes and reasons to play, and present them along with their corresponding taxonomies. The overview we created indicates great connectivity between these taxonomies and we would suggest to develop a framework for gamification that includes a user classification that specifically assesses the elderly user. We base this classification on the Five Domains of Play model that predicts the existence of a relation between preference for game content and personality.

[2] Exploring relations between personality and game preferences: a pilot study
This study investigated the relations between personality and game preference by means of an online questionnaire, in order to tailor game content to the needs of individuals or user groups. Results show that several significant correlations exist for persons younger than sixty years old, but they are minor. No significant relations have been found for participants of sixty years and older.

[3] Game preferences and personality of older adults
This study again explores the relation between personality and game preference to enable creation of a user classification targeting the older adult user. The study included two questionnaires and a semi-structured interview and participants were given tablets with a set of specific games to play during 5 days. Results show that older adult users have a strong preference for a game with high Novelty content, although significant correlations between personality and game preference were not found. A possible explanation for this observation may be that an extensive experience with video games, only acquired when growing up playing video games, is essential for being able to classify user preferences in a model such as used in this study. Further analysis of game preferences of the individual participants – combined with the monitored use time data of the games played with qualitative information from interviews – enables us to design guidelines that can be translated into tangible design that is tailored to the end user.

Future Work
In future work, our study findings are put in practice within the gamification layer of the PERSILAA project. An evaluation study instigates a second design iteration for the final product and allows us to gain more insight in the opportunities of game design for the older adult.

References
[1] The full paper titled: ‘Engaging elderly people in telemedicine through gamification’ is accepted for publication at Journal of Medical Internet Research (JMIR Serious Games). In press, DOI: 10.2196/games.4881.
3.10 Gamification concepts and realization

The gamification concept and realization

Frederiek de Vette and Hermie Hermens
University Twente, Telemedicine group, Enschede, The Netherlands

Marit Dekker (RRD), Alejandro Garcia (FPING)
Javier Solana (UPM), Antonio Ferreira (FFCUL)

Introduction

The gamification layer focuses on the reinforcement of engagement through meaningful interaction, taking into account study results on the game preferences of the older adult user. The gamification layer is envisioned as a full game environment, or virtual world, in which the performance of the user on various building blocks of the platform is translated into progression in the game.

Methods

1. Information structure and measuring performance

The data that indicates the user’s performance is referred to as performance indicators, which we translate into imaginary ‘game units’. This enables the creators to perform normalization and add thresholds. The game units decide the core gameplay by dictating the progression the user can make in the game. Fig. 1 illustrates the information flows between different structures. Performance indicators were determined in dialogue with each partner responsible for a module.

2. Game content design guidelines

From our studies we find that certain requirements should be followed to create an engaging game experience for the older adult user. We combine our own observations with existing research for designing digital user interfaces and exergames. Usability guidelines focus on age-specific visual, auditory, motoric and cognitive abilities, plus particular interaction and game-related requirements. Secondly, we aim to create a model for tailored game content that allows for such complexity to engage a large part of the group of elderly users that is intrinsically interested in games. These categories follow from the 3D theory (see demo poster).

- Design for a variable level of novelty (‘familiar vs. novel’)
  - Fantasy, artistic, interest, adventure
  - Clear boundaries, predictability
  - Triggering curiosity
  - Problem solving, logical reasoning, intellect

- Design for a variable level of challenge (‘intention vs. achievement’)
  - Game objectives are non-obligatory (or adjustable difficulty setting)
  - Player is given the opportunity to challenge him/herself; game objectives for ‘intentional’ playing (highs) and achievements must be available
  - Intratextuality, or a very slow learning curve; tutorials

- Design for a low level of threat
  - Avoid triggering negative emotions: tension, stress, a disturbing setting (horror, gloom), humiliation and frustration, the sense of danger or anxiety
  - Create a relaxed, cheerful atmosphere, comforting, warm, calming

- Design for a high level of harmony
  - Avoid elements of boasting, competition, unfairness and violence
  - Focus on cooperation, altruism and compassion: cute, gentle

- Design guidelines for stimulation
  - Avoid exciting, high-pace, thrilling game elements
  - Create options for solo play as well as for a social/multi-player mode

3. Core gameplay and graphic concept

PERSILIA+ Islands is a tablet-based 2D point-and-click adventure. In the game, the player is an adventurer that is shipwrecked on an unknown island in a storm, who has to retrieve boat parts and repair tools that have scattered all over the island. Every next level is opened after passing a threshold of performance on the platform. From completing each level, that will have a puzzle/mystery character, a boat part or tool can be gained. Eventually, when the user has completed the boat, a next island will be made available to explore (fig. 2). The levels will be created in such a way that they can serve as playful elements that can be revisited daily. The monitoring layer is connected in a special way to the game environment: an achievement is reflected through the arrival of a message in a bottle that contains an item that can be stored in a trophy cabinet, accessible through the home-screen. A future version will incorporate the social component by adding the ability to take photographs of scenes and environments and share them with others.
3.11 Intelligent core

The intelligent core

Javier Solana and Francisco Garate
Biomedical Engineering and Telemedicine Center
UPM, Madrid, Spain

Hossein Nassabi (UT)
Hermie Hermens (RRD)

Introduction

PERSILAA defines a set of services in order to screen and prevent functional decline related to frailty. For that purpose, this project has designed and developed a screening method that allows us to collect enough amount of data that is relevant to determine the frailty status of a person. Besides, we have defined a monitoring layer that aims at feeding with periodic information coming from questionnaires, a network of sensors and the results obtained by users when performing the activities and tasks scheduled in the different training modules (GNPT, CoCo, and the Nutriaging website).

Furthermore, a gamification layer tries to define an effective strategy for designing gamification for elderly, increasing the motivation and adherence to the service. Below everything comes the intelligent core, managing all the information gathered from older adults in order to provide advanced methods for increasing the efficacy of the services provided.

Intelligent core

This intelligent core module gets information from the three mentioned main services of PERSILAA (screening, monitoring and training), analyzing and processing it in order to automatically detect changes and behaviour and do proper personalized suggestions, by comparing results of users that have similar characteristics and necessities.

![Diagram of the intelligent core concept](image)

Figure 1: The Intelligent core concept in process.

![Diagram of the PARS exercise recommender system](image)

Figure 2: The PARS exercise recommender system.

Conclusion and Future Work

The intelligent core has been already defined, and a first version will be implemented and integrated before March, and we can test it and study if there are significant differences compared to those who have been using the PERSILAA services without this intelligence behind. The first version of the PARS exercise recommender system has been implemented. As future work, the recommendation algorithm will be modified so that it considers the changes to the health state of end-users.
Dutch pilot site: study set-up

Introduction
PERSSILAA is a unique project that aims to develop and evaluate a new service model for older people, to screen for and prevent frailty. The objective of the Dutch pilot site evaluation study is to investigate the user satisfaction, use, effectiveness and economic outcomes of the PERSSILAA platform for older adults suffering from functional decline on the physical and/or cognitive domain and/or suffering from malnutrition.

Methods
This study is a cohort multiple Randomized Controlled Trail (cmRCT)[1]. A multidimensional screening tool is used to detect community dwelling adults suffering from functional decline in the physical and/or cognitive domain and/or suffering from malnutrition. Selected people were asked to participate in a research cohort and fixed numbers of participants will be randomly assigned to the intervention group each time a new service module of the PERSSILAA platform is ready for validation. The PERSSILAA platform is an online platform which gives older adults and healthcare professionals access to various modules: a screening module, training modules and a monitoring module. The main study parameters are: user satisfaction (UTAUT) and use (page hit analyses) regarding the PERSSILAA platform, the quality of life (SF-12: physical component summary and mental component summary), effectiveness of the PERSSILAA platform (RAND-36-PF, AD8 and MNA-SP) and the demand of care. The research cohort of older adults is asked every 3 month to complete these questionnaires.

Results and Future Work
At this moment 55 older adults (one drop-out) are participating in the evaluation cohort. These older adults are asked every 3 months to complete a questionnaire to monitor their health status. In January 2015 the first release of the PERSSILAA platform (standalone version of the physical module) was evaluated and 22 older adults were randomly asked to use the platform. Eventually 17 users actually started to use the platform, during the training period 3 persons dropped out. In June 2015 another 12 older adults were added to the cohort and a second release of the PERSSILAA platform (integrated platform with access to physical and cognitive training module) was available. Fourteen older adults were randomly asked to use the platform and 11 of them actually started (2 drop outs during this period). In the third year of the project two more RCT’s are planned to evaluate the next released of the PERSSILAA platform.

Future work
Based on the second round of the first screening new older adults will be asked to participate in the research cohort. Two more RCT’s are planned to evaluate the next released of the PERSSILAA platform.
- January 2016: 3rd release of the PERSSILAA platform (new: nutrition website)
- July 2016: 4th release of the PERSSILAA platform (new: gaming environment)

References
3.13 Italian pilot site: study set-up

**Italian pilot site – Study setup**

Laura Vuolo and Maddalena Illario  
Azienda Ospedaliera Universitaria Federico II,  
Napoli, Italy

Pascuale Izzo (Nexera)  
Javier Solana (UPM)  
Hermie Hermens (RRD)  
Miriam Vollenbroek-Hutten (UT)

**Introduction**

Ageing can be considered a success outcome for health policies. PERSILAA project has the goal to develop a new health service for detecting and preventing frailty among older adults that uses innovative eHealth service with a strong basis in their local communities. The service was initially developed for and implemented in two sites: Campania in Italy and Enschede in the Netherlands. As in Campania region religion and spirituality play a large role in the life of older adults, the communities of local Catholic Churches were taken as the starting point to the services design.

**Methods**

The scale up of Persilaa foresees a stepwise involvement of Catholic Churches communities through an iterative model design.

**Phase 1:** A referent of the Community contacts FOUND Research and Development Group.

**Phase 2:** An introductory meeting between the Community referent and the Project coordination is held to illustrate the proposed services and check feasibility. A date is fixed for a meeting with the older adults and volunteers of the community, that is publicized for 2 weeks.

**Phase 3:** The information meeting between FOUND project staff and older adults is held at the community.

**Phase 4:** Training of the Community referents on PERSILAA.

**Phase 5:** Operationalization of the activities:
  - Enrolment & Screening 1
  - 1 cycle of 6 meetings about ICT literacy
  - Face-to-face physical activity, embedded with ICT literacy, twice/week
  - 3 cycles of 4 meetings each, focused on Health/Nutrition literacy, embedded with ICT literacy
  - Screening 2 through periodically scheduled visits and clinical parameters assessment

ICT supported tools (device, neuropersonals trainer, gamification layer: nutrition website) have been integrated with ongoing activities as soon as they were available and targeting the older adults subgroups that were ready to use them.

**Results and Future Work**

- So far:
  4 Catholic communities joined Persilaa Project
  86 older adults completed First and Second Screening assessments

New enrollments are already ongoing and other churches will join PERSILAA project.
3.14 Business development

Exploitation of PERSSILAA
For an active & healthy ageing future

Wander Kenter, Hermie Hermens
Roessingh Research and Development,
Telemedicine group, Enschede, The Netherlands

Persilaa Exploitation Taskforce (PET)
Maddalena Illiano (FOUND), Pedro Moreno (UPM)
Stanislao Forte (Nexera), Alajandro Garcia (FPING)
Bruno Amaro (FFCUL)

Introduction
To reach (commercial) exploitation of the PERSSILAA platform and modules – a strategy is created and adopted. The strategy will, when executed, enable a) to build business cases for commercial exploitation b) to create a living framework of PERSSILAA exploitation methods and c) to do research into exploitation of telemedicine applications using PERSSILAA platform and modules as cases. The PERSSILAA Exploitation Taskforce (PET) takes the lead in the WP6 tasks and connected WP5 activities.

Strategy

- The PET set an exploitation strategy as shown in figure 1.
- Value generation based on input from consortium and relevant stakeholders resulting in value proposition.
- Business modeling using the general definition of a business model by Bouwman et al. [1] to be trialed at pilot locations (WP5 activity - measured by predefined KPIS).
- Business plan inputs (e.g. IPR, market analysis, regulatory assessment) will be assembled by the PET.
- Outcomes of the trials, together with revenue scenarios, cost-effectiveness assessments and business plan inputs, will serve as business plans.
- Sensitivity analysis and a combination of iterative loops, qualitative and quantitative methods will ensure continuous up-to-date information and sustainable development of PERSSILAA business cases [2, 3].
- Lead generation with interested external partners will lead to exploitation agreements/MoU’s for commercial exploitation plan[4].

Results & Future work

The value proposition: “ICT services to increase self awareness, promote active and healthy ageing and prevent functional decline in ageing society” is the start of two business cases piloted in Campania and Twente.

The next phases in the strategy will use the great innovative and clinical validated potential of the PERSSILAA platform services to reach and partner up academia, the healthcare professionals, policymakers, insurers and commercial partners. Commercial exploitation agreements with external partners and possible investors will enable upscaling of the PERSSILAA platform services and role-out scenarios to different regions.

References

4 Conclusions

This document gives insight in the work and progress done so far after two years of the project. Of course, all the relevant ideas and concepts which have shaped the PERSSILAA project are presented here. Also the service model definition, explaining how the project aims at screening and preventing frailty in older adults. Since PERSSILAA proposes an ICT based solution to provide the services to final users, the platform and ICT architecture is presented on a poster too.

Then, the main services and modules used through the PERSSILAA platform are presented: first, the screening; second, the monitoring layer; and finally, the three specific-domain training programs (physical, cognitive and nutrition).

Not only the gamification studies and the first implementations done, but also the intelligent core, are addressed in this deliverable too. One of the main challenges of the PERSSILAA project are those activities that will differentiate our service model from other solutions, resulting on an outstanding and ground-breaking new way of providing services for the screening and prevention of frailty. In this regard, both the gamification and the intelligent layer play a key role.

Finally, the two different study set-ups are described for the Italian and the Dutch situations, where PERSSILAA is offering its services. Furthermore, the exploitation strategies and business modelling tasks that will enable to extend the defined services provided in the future are described in the last poster of the document.

As it was said before on the introduction section, every poster is designed in such a way that they could also suffice as stand-alone dissemination material. So, in the coming future we envision to reuse these materials for disseminating the project’s results on conferences, workshops, lectures or other dissemination events.

To conclude, it is also interesting to remark how Technology Readiness Levels (TRL) are increasingly taking the attention nowadays on the ICT solutions market, since they are a method of estimating technology maturity of a program during the acquisition process. The use of TRLs enables consistent, uniform, discussions of technical maturity across different types of technology. This can be considered relevant in the context of PERSSILAA project because the work done so far addresses both tools and techniques that are in lower TRL levels (i.e. the screening methodology, some parts of the monitoring layer, the intelligent core or the gamification layer), but also tools and modules that are being already tested and implemented, and by this have higher TRL scales (the training modules like Neuro Personal Trainer and CoCo). Therefore, after looking all the created posters for this demo, the reader will see these two apposite TRLs, from low to high levels of matureness.