pia

D2.5 Web-based tool for IADL, carer stress and IADL-related QoL analysis

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1   Introduction

This report documents the first stable version of the PIA web analysis tool software. The basis of this software system corresponds to the methodology detailed in Deliverable 1.4, which defined the principles of the IADL level, carer stress and QoL analysis by using interactive systems, taking into account the user and the elements of the environment. Besides, that methodology can be used as a guideline to develop this software analysis tool.

Moreover, the set of requirements and the overview of these analysis tools were explained in Deliverable 2.1 as a part of the general PIA system.

In a general way, the system presented in this document consists of a set of three applications or modules focused on four kinds of user (elders, carers, researchers and administrators). One module is responsible for monitoring and checking the stress/QoL level of the carer, and the QoL/IADL level of the elder. Another module is created perform analysis tasks such as questionnaires completion and visualisation, receiving an automatic feedback from the application etc. Finally, the whole system has an administration panel to be managed by administrators who can change everything within the analysis tool. All applications have been developed taking into account the standardised principles of interaction design[1]

On the other hand, as a complement of this tool, an API based on REST protocol[2] has been developed to communicate with other PIA tools, for example to gather information from external events or interactions between users (e.g., elders at home) and environmental elements (e.g., NFC objects).

The analysis of IADL, QoL and carer stress is performed through test completion and gathering of information from external events provided by other PIA applications (see Deliverable 1.4). This tool provides a support for creating specific questionnaires according to the premises of a particular analysis, saving the results for further analysis.

1.1   Deliverable dependencies

This deliverable has dependencies with the following ones:

- **D 1.4 (Methodology for IADL, carer stress and IADL-related QoL analysis)**. This methodology aims to design a framework for the analysis. Also, it will help to guide the evaluation procedure of QoL during trial tests.
- **D 2.1 (Prototypic system of the PIA concept)**. This document refers to the PIA implementation of the whole prototype, describing the parts of the system and its functionalities.

1.2   Document content

This document is divided into several parts according to the different modules of the analysis tool. Each part is detailed, describing its functionalities, goals and capabilities. The aim of this document is to provide the reader the knowledge about these tools and the usefulness of each. Also, generalities about the communication between this system and other PIA applications are explained.

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[1] http://asktog.com/atc/principles-of-interaction-design/
[2] http://rest.elkstein.org

2   Analysis tools overview

All the modules or applications for the analysis are accessible from anywhere via the internet as web responsible applications. The main page shows general information about this tool, containing direct links to the modules for the analysis. Figure 1 shows a screen capture of the main page focused on applications section.
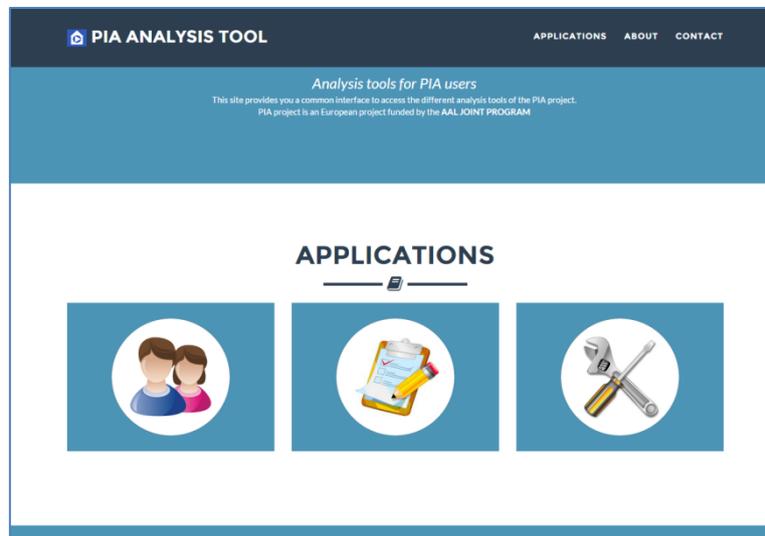
Figure 1. Main page: web analysis tools.

Registered users can access the corresponding web module. Each of the icons corresponds to an application/module as Figure 2 shows.

Figure 2. Modules of the analysis web tool.

The role of the user determines the module access. Each module is independent, but all comprise the complete tool. Besides, other PIA applications (e.g., mobile PIA apps) can communicate with this analysis tool by means of a web service API which allows gathering relevant information for the analysis which is not collected directly by the own analysis tool.

Figure 3 presents the components of the PIA system identifying the analysis web tool from a more technical viewpoint.
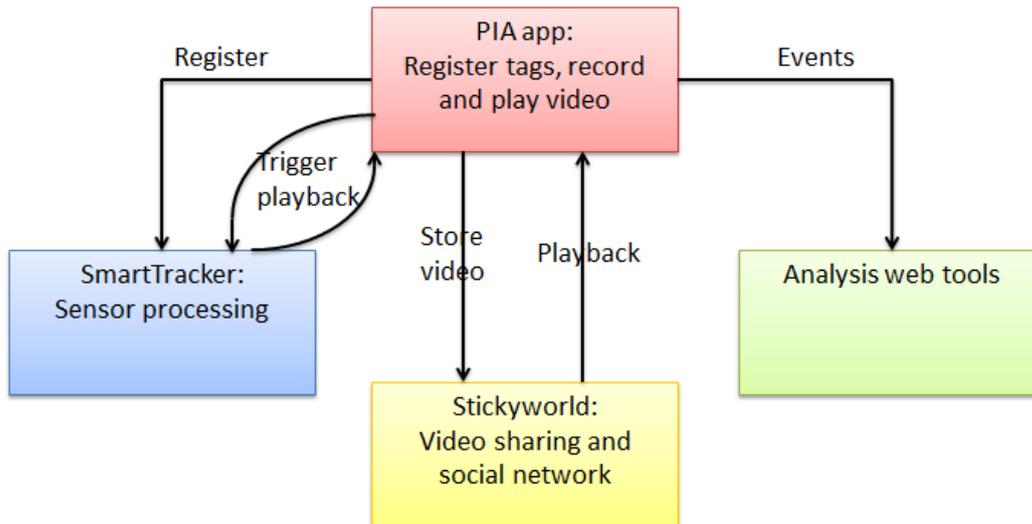
Figure 3. Overview of the PIA system.

2.1   Users of the analysis tool

The analysis tool will be used by carers (formal and informal) and researchers, having a dual purpose.

- **Carers** can perform tests proposed by researchers about stress and burden, quality of life and IADL aspect (related to the elders they take care of). Additionally, carers will monitor the status of their tests and what their elders are doing in the environment (through the data provided by the mobile apps).
- **Researchers** are responsible for knowing the condition of the carers and elders registered in the PIA system, by means of activities monitoring. Additionally, researchers can create new tests to be completed by carers (e.g., to know the evolution of a carer, distinguishing between two points: before the use of PIA videos app and after use of PIA videos app).

In this project we talk about PIA users such as researchers. However, for example, researcher could be any researcher, not just in PIA scope. Thus, our application can be used in other domains that require a similar analysis of users.

The roles of elder, carer and researcher keep several types of relationship. Figure 4 shows this.


Figure 4. Network/relationships between existing users of the analysis tool.
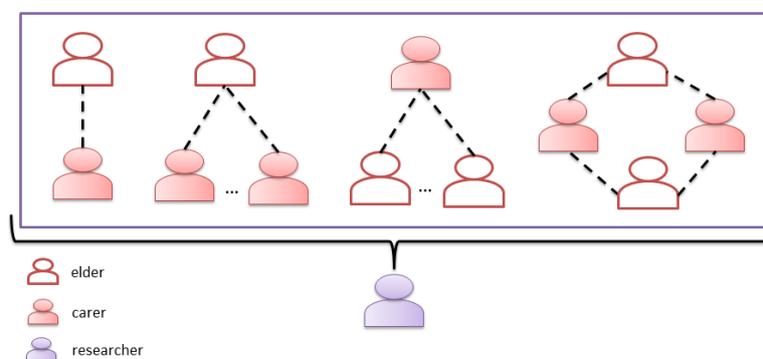
The analysis tool must identify each user to display the appropriate information. Internally, elders will be associated with carers, and carers will be associated with researchers (favouring a division by groups if necessary). Thus, every user should have a profile or account in the PIA system.

On the other hand, there is a module for administration. This module is managed by administrators. This kind of users knows the web tool and they could have access to all the information stored, in order to maintain the system or resolve other system conflicts.

3   Web module for carers

Each module has a login page to access the functionalities of this module. Figure 5 shows the login page to access the web tool for carers.
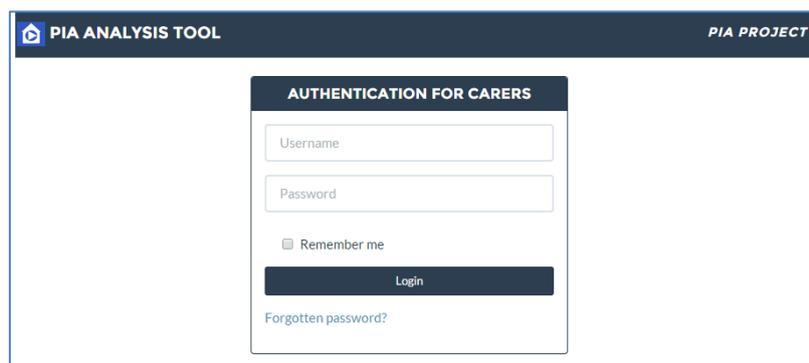
PIA ANALYSIS TOOL   *PIA PROJECT*

AUTHENTICATION FOR CARERS

Username

Password

☐ Remember me

Login

Forgotten password?

Figure 5. Login page (module for carers).

When the user accesses the carer's platform, a main page shows all the pending tasks to do by that user. Normally, these tasks correspond to tests and questionnaires to be completed before a specific date in order to send feedback to researchers, about any of the aspects to be analysed (IADL, QoL and stress). Figure 6 presents an example of home carer page related to a fictitious carer identified on the top right (Normally, IADL tests refers to the elder that the carer cares for).
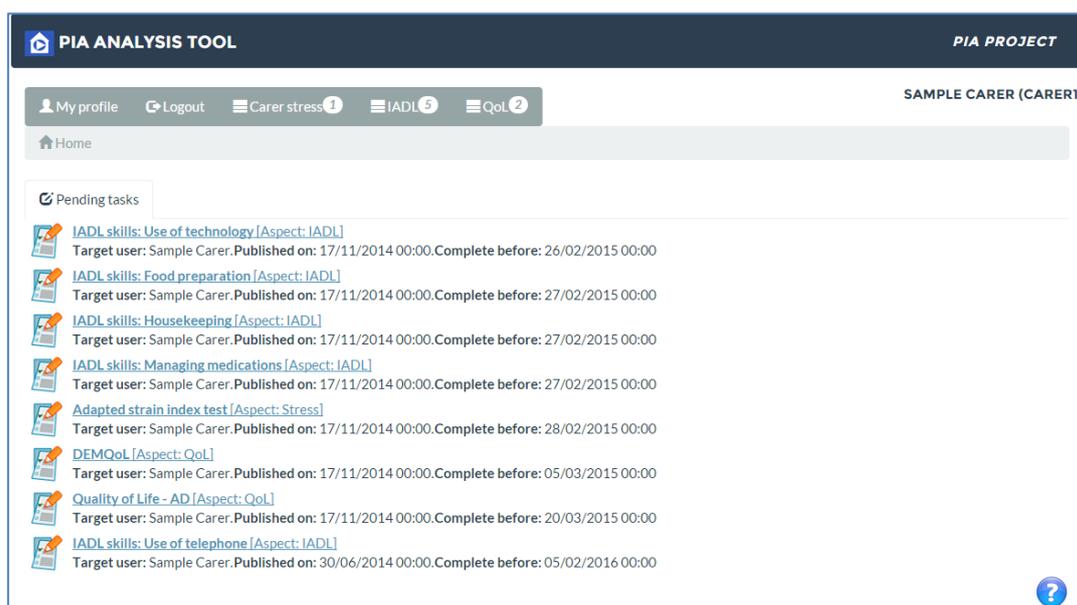
PIA ANALYSIS TOOL   *PIA PROJECT*

SAMPLE CARER (CARER1)

👤 My profile   ➔ Logout   ☰ Carer stress ① 　☰ IADL ⑤ 　☰ QoL ②

🏠 Home

☑ Pending tasks

IADL skills: Use of technology [Aspect: IADL]
Target user: Sample Carer. Published on: 17/11/2014 00:00. Complete before: 26/02/2015 00:00

IADL skills: Food preparation [Aspect: IADL]
Target user: Sample Carer. Published on: 17/11/2014 00:00. Complete before: 27/02/2015 00:00

IADL skills: Housekeeping [Aspect: IADL]
Target user: Sample Carer. Published on: 17/11/2014 00:00. Complete before: 27/02/2015 00:00

IADL skills: Managing medications [Aspect: IADL]
Target user: Sample Carer. Published on: 17/11/2014 00:00. Complete before: 27/02/2015 00:00

Adapted strain index test [Aspect: Stress]
Target user: Sample Carer. Published on: 17/11/2014 00:00. Complete before: 28/02/2015 00:00

DEMQoL [Aspect: QoL]
Target user: Sample Carer. Published on: 17/11/2014 00:00. Complete before: 05/03/2015 00:00

Quality of Life - AD [Aspect: QoL]
Target user: Sample Carer. Published on: 17/11/2014 00:00. Complete before: 20/03/2015 00:00

IADL skills: Use of telephone [Aspect: IADL]
Target user: Sample Carer. Published on: 30/06/2014 00:00. Complete before: 05/02/2016 00:00

Figure 6. Home carer screen capture.

A navigation bar with a notification system provides the carer a mechanism to know the most relevant things of each aspect to be analysed: Carer stress, IADL and QoL. The badges close to these domain names indicates news to be considered as Figure 7 presents.

Figure 7. Notification badges for user news.

All web pages of the application have a help icon on the bottom right, which provides some tips about the items of the current page (see Figure 8).
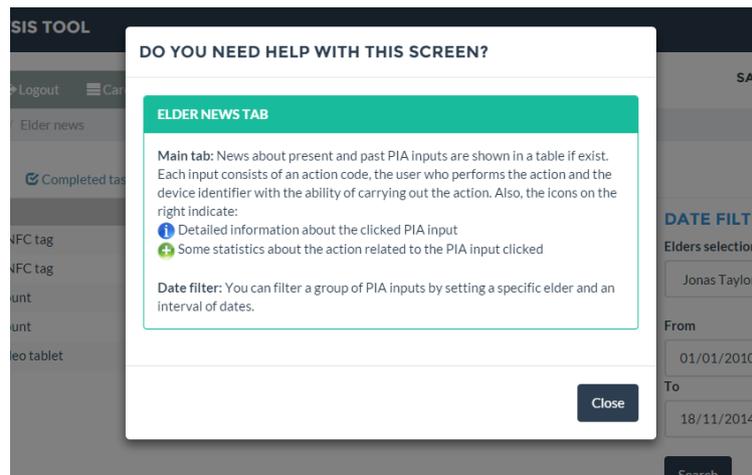

Figure 8. Example of help screen dialogue.

Moreover, the carer can access the specific news and analysis information from the navigation bar.

3.1   Carer stress component

If the user wants to know his/her news regarding carer stress level, he/she can do it by pressing on the "carer stress" button on the navigation bar. The web application shows the information about pending tasks and completed tasks related to stress level, associated with that carer. In the tasks completed, the user can watch additional information about his/her final score in, for example, a questionnaire completed some days before. This feedback can be given to the carer. Figure 9 shows the web page of the carer stress aspect.

Figure 9. Carer stress web page.

In the example shown in the figure, the user has a pending task which corresponds to a test released by a researcher or administrator. Also this test is identified by the target user (in this case the same logged), a date in which the test was published, and a date as a deadline for the test completion by the user. The completion of tests by the user will be shown in the next section.

Completed tasks tab indicates all the questionnaires performed by the user and when these were finished. Some information about the test completed is available to the user. Usually, the user will have access to the final score (for scoring tests) and a textual result (see IADL component).

When no pending or completed tasks are available, it is presented conveniently to the user as Figure 10 shows.

Figure 10. Competed carer stress tab (with no new tasks).

All the pages have a box for searching purposes. In this sense, the user will be able to find any questionnaire between a pair selected dates. Figure 11 shows a screen capture of this tiny search engine.

Figure 11. Search box to filter user questionnaires

3.2   Quality of life (QoL) component

Similarly to the carer stress component, a carer can visualise his/her news regarding the QoL aspect. In this case, questionnaires to measure QoL levels are grouped in pending tasks tab and the completed ones are shown in completed tasks tab. Our fictitious carer has two tests to be completed as Figure 12 presents. The rest of the web elements have the same functionalities as before.

Figure 12. QoL level tasks web page.

A "breadcrumb" (web page path) bar identifies where the user is in the web application.

3.3   Instrumental activities of daily living (IADL) component

Again, the elements in this web page work in a similar way as before. However, in the IADL section there is a new tab called "elder news". This tab shows all the actions carried out by the elders associated with the logged carer. Figure 13 presents an example of IADL elder news for the given carer. In this screen the actions related to a specific elder are shown.

Figure 13. Elder news tab in IADL web page.

Moreover, two buttons for each action are enabled with detailed information about the action and some statistics of that (from last year to now). Figure 14 (a) shows general information of the action, and Figure 14 (b) an example of statistics for that specific action.

| (a) | (b) |

Figure 14. Action details: information and statistics.

In this page, the search box includes a dropdown component to select a specific target user (associated elder), retrieving all the actions for that user (including dates filtering).

3.3.1   PIA input gathering

Applications of the PIA system provide inputs to the web analysis tool. These inputs correspond to different relevant actions to be analysed. For example, a PIA input could be created when an elder interacts with an instructional video on his/her tablet. In the IADL web page of the application the PIA inputs are characterised by the following:

- **Action**. Code and name of the action (e.g. play video on a tablet)
- **Target user**. User who performs the action
- **Device**. Identifier of the device, source of the action
- **Performed on**. Datetime field indicating when the action was performed

In next sections a more detailed explanation about PIA inputs and gathering of these from other applications are given.

3.4   Test completion

Questionnaires are used to assess several aspects related to IADL, stress and QoL of the users. The questionnaires previously created by researchers are shown as pending tasks in the carer web site. Every questionnaire consists of blocks of questions and responses per question. There are the following types of questionnaires to be completed by the user:

- Standard. This test consists of several common fields and a set of blocks of questions, and each question can have one or more possible answers. Three types of responses are possible: exclusive, multiple or text.
- Interactive. This test consists of a set of blocks with only one question per block (with multiple or exclusive choices), such as, next questions depend on the responses to that question. Figure 15 shows an example of flow of an interactive test which could be completed. Different block of questions are shown depending on a previous answer.
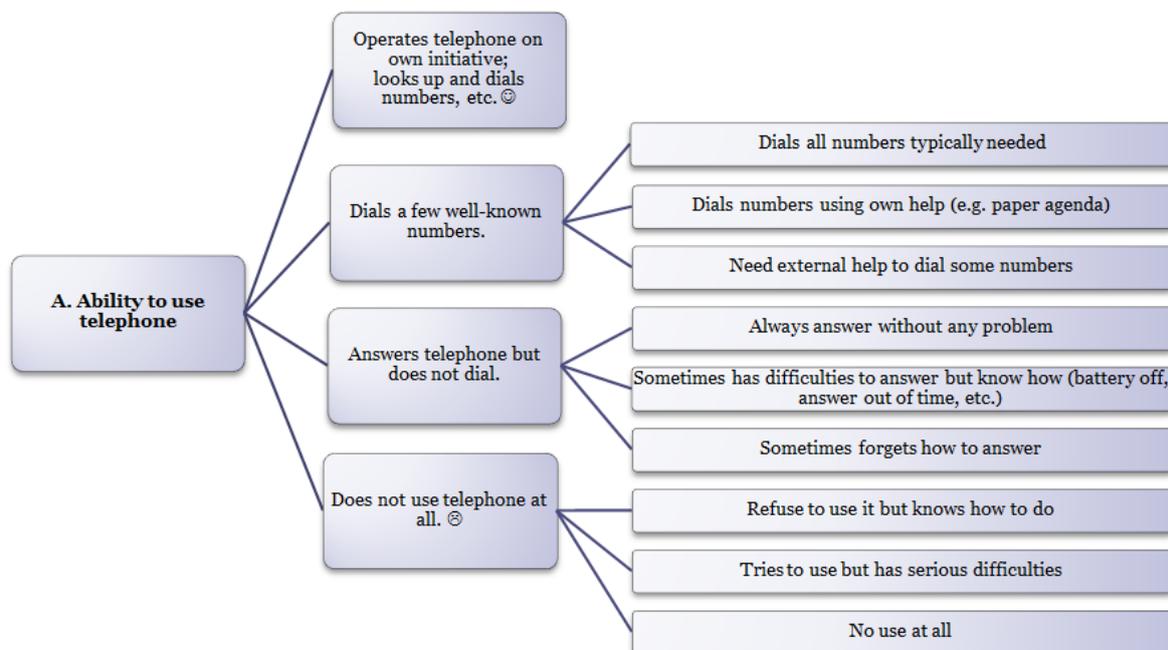

Figure 15. Example of theoretical flow of an interactive questionnaire: Use of telephone.

A typical test performance comprises three parts: ***Beginning***, showing some initial information about the test (see Figure 16); ***blocks sections***, showing the block or blocks of questions to be answered (see Figure 17); and ***ending***, displaying a brief feedback with some recommendations to the user (Figure 18). The test completed is saved in the corresponding completed tasks tab at the web application, and the results are stored in the PIA system for the analysis by researchers.

Figure 16. Initial screen of a completion test.

Figure 17. Example of blocks of questions.

Figure 18. Example of ending of a test completion.

Commonly, there are three buttons along the questionnaire: **Exit** to abandon the test completion (partial responses are saved), **Back** to go back in the questionnaire, and **Next** to go next question of the test.

4   Web tool for researchers

A researcher with privileges can know the results and information of carers and elders associated with him/her. This module of the PIA analysis platform provides a support to external inputs and questionnaires management.

4.1   PIA questionnaires management

Researchers can create and edit test templates to know the state of primary or secondary users based on considered measures (IADL level, stress level and QoL level). As it was mentioned in a previous section, there are two kinds of questionnaires to be created: standard and interactive tests.

4.1.1   Standard test creation

The creation of a standard questionnaire is characterised by a sequence of steps which is guided by the web tool.

Test general information. The first step for creating a test, is to provide general information about it. This includes the type of test (standard), a name, a brief description and a text to help with the result interpretation (e.g., if it is a scored test or not), the measure to be measured and the name of the researcher who created the test (see Figure 19). This step is common to the interactive test creation.
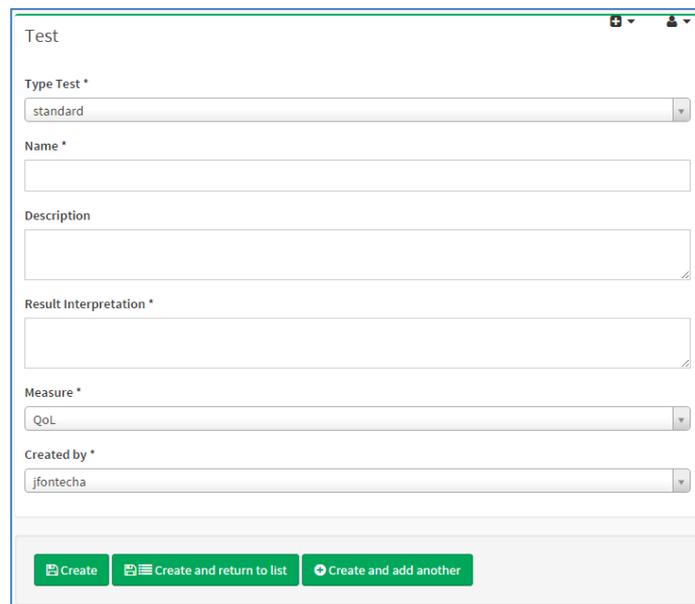
Figure 19. Test creation (general information).

Blocks and questions management. A test consists of a group of blocks of questions. Thus the researcher has to create each of these blocks. The web tool provides him/her the necessary tools to do this. Figure 20 shows an example of a block of questions to be created for a specific test (previously created). The user defines the following items: name of the block, position of the block in the questionnaire, and questions per block. In this case, each question can be exclusive, multiple or

text. The web tool will identify the type of the question at run time, creating the text field with the appropriate option/s.

Figure 20. Block of questions creation.

Questions and responses management. Questions of a block can be edited to add responses to these. For example, if the researcher defined an exclusive question, the researcher can create one or more responses with scores associated with (see Figure 21).

Figure 21. Questions and responses creation

Test scores. Questionnaires with scores help the researcher to interpret the results as well as to facilitate to the user who completes the test recommendations as a feedback in the carer web tool. Thus it is advisable researchers define recommendations based on the result of the created test.

Figure 22 shows an example of a new score for a specific test with the maximum and minimum score and the corresponding result interpretation for that range.
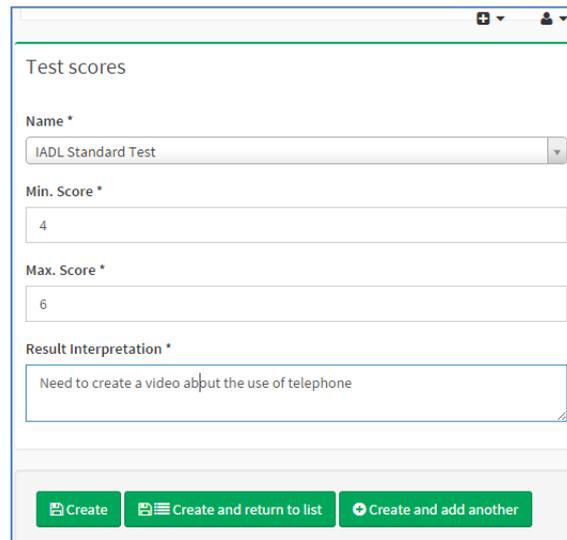
Figure 22. Example of test score definition.

4.1.2   Interactive test creation

The creation of interactive tests is similar to a standard one but with some differences. In this case, the test type will be "interactive" and each block consists of a unique question, and the questions are usually "exclusive".

The interactive test is characterised by linked questions which define the path to the final result (and therefore to the final score). Thus, all questions that depend on other should have a "linked item". Figure 23 shows an example of linked question where a particular response ("does personal laundry completely") in a previous question guides the user to the next question ("separation of clothes").
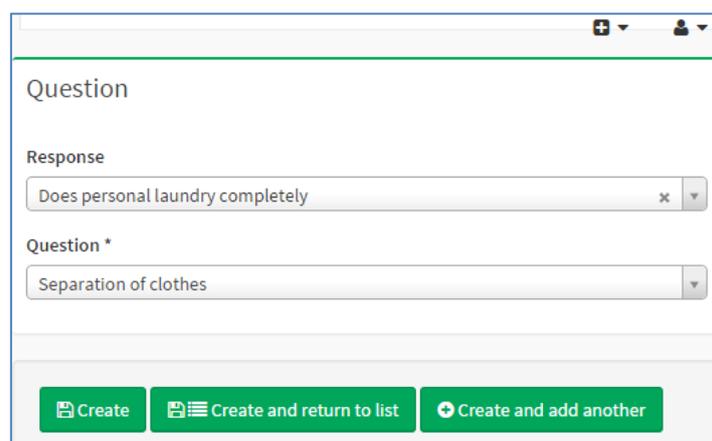
Figure 23. Example of linked question in interactive tests.

4.1.3 Test assignments and stages

After test creation, the researcher decides when the test will be public or available to the corresponding user (carer) at the web tool for carers. Besides, each assignment is characterised by three relevant dates:

- **Publication date**. This date is taken into account to publish the test in the assistive system. A researcher can publish the test at a specific date.
- **Deadline date**. A test assignment can have a deadline and before that, the test should be completed by the corresponding user.
- **Completed date.** This date identifies the datetime in which the user completed the assigned test. The completed date must be previous to the deadline.

Figure 24 presents an example of addition of a new test assignment. Also, Figure 25 shows an excerpt of the test assignments list displayed on the researcher tool.

Figure 24. Parameters of a new test assignment.

	Assignment date	Test	Assigned to	Assigned by	Publication date	Deadline	Completed date
	April 23, 2014 12:57	IADL Standard Test	carer1	jfontecha	July 15, 2014 00:00	October 23, 2014 00:00	
	June 2, 2014 11:35	IADL skills 1	carer1	jfontecha	July 14, 2014 00:00	December 25, 2014 00:00	November 19, 2014 10:19
	June 24, 2014 11:41	IADL skill: Laundry	carer1	jfontecha	June 23, 2014 00:00	February 5, 2016 00:00	November 16, 2014 15:30
	June 30, 2014 10:43	IADL skills: Use of telephone	carer1	jfontecha	June 30, 2014 00:00	February 5, 2016 00:00	

Figure 25. Example list of test assignments.

Finally, the created questionnaires will be shown to the corresponding users at the carer web analysis tool (see section "test completion").

On the other hand, the researcher can establish one or more assessment stages to facilitate the analysis task. Thus, all the completed tasks from the carer web tool could be grouped into one stage or another. For instance, the researcher could identify two stages: at the beginning of the carer

analysis tool, and after a time frame using the web tool (e.g., six months). In this way, the researcher could make evolutionary studies for a group or a particular carer/elder. Figure 26 shows a screen capture for adding a new assessment stage.

Figure 26. Example of addition of a new assessment stage.

Results of all completed questionnaires associated with users (carers) can be consulted in the web tool because of these are saved into the database. Besides, the researcher can create a test once and use it on different users. This happens because the created test works as a common template and the results from that test template are saved for each user who completed the test.

4.2   PIA inputs management

Inputs are known as events caused by other PIA applications of the PIA system, and these are associated with a specific user and action (see section "PIA input gathering"). All the inputs generated by the external applications are listed and monitored in the researcher analysis tool (and also, in the IADL web page at the carer tool). Researchers can know when the inputs have occurred and who has carried out the interaction. Figure 27 shows an example list of PIA inputs presented to the researcher, including inputs from carers (in the other PIA apps) and elders (at home).

	Device Id.	Datetime	Action	User
☐	mobile0001	February 11, 2014 12:21	Create PIA account	susancarer
☐	web0001299	February 21, 2014 09:27	Add video	marcusgunt
☐	web0002	February 21, 2014 09:50	Login	susancarer
☐	mobile0001	February 21, 2014 09:51	Play video tablet	jonast
☐	mobile0001	February 24, 2014 16:51	Edit account	jonast
☐	mobile0001	May 20, 2014 16:54	Edit account	jonast

Figure 27. Example of PIA inputs list.

5   Web tool for administrators

This is a back-end or administration panel accessible from the main web page of the analysis web tool. Everything can be managed at this web site. The administration panel includes CRUD[3] opera-

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[3] Create, Read, Update and Delete

tions to manage the information of the PIA analysis tool. Figure 28 presents an overview of the dashboard panel, showing an example of users of the administration tool.
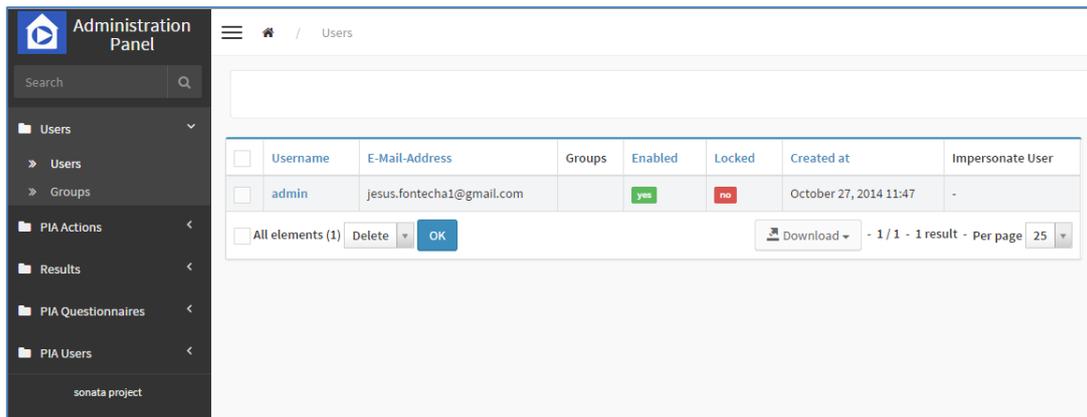

Figure 28. Administration panel of PIA analysis tool.

The administration tool is able to manage the following items (all of these available in the left menu of the web panel):

- **Users**. The users of the administration tool can be managed and their privileges modified. Also, groups of users can be created (see Figure 29 (a)).
- **PIA actions**. Actions and action sources for PIA inputs. With this option, the administrator can create new actions and modify existing ones (see Figure 29 (b)).
- **PIA users**. Data about researchers, carers and elders. Also roles of each can be configured (see Figure 29 (c)).
- **PIA questionnaires.** The administrator has access to manage everything about question-naires and tests, including the following: measures to be measured, tests, blocks of questions, responses, test scores and linked questions of interactive tests (see Figure 29 (d)).
- **Results.** Inputs, assessment stages, test assignments and results of questionnaires can be managed by administrators (see Figure 29 (e)).
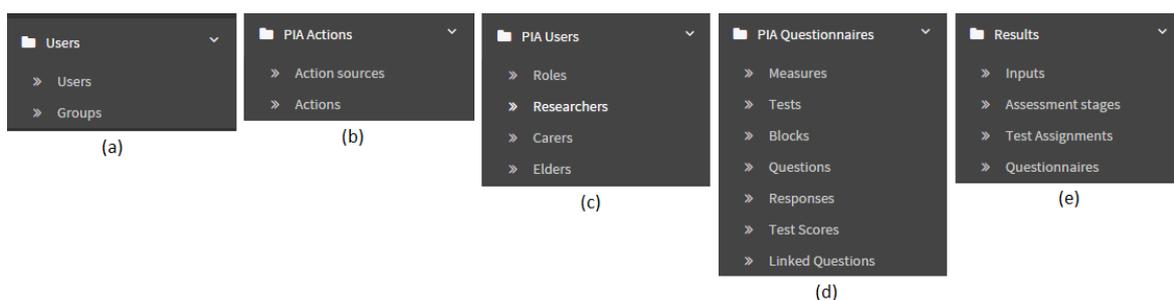

Figure 29. Information managed in the administration panel.

Administration tasks are important to ensure optimal maintenance of the web application. It is im-portant that the administration tool is handled by users with knowledge about CMS[4] administration.

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[4] Content Management System

6   Gathering information

One of the main goals of the analysis tools is to gather as much relevant external data as possible, in order to facilitate treatment and monitoring of primary and secondary users. It will improve future clinical decisions and caring tasks.

External applications provide information about the interactions between users and elements of the environment. The analysis tool has an API to collect all of this information.

Primary and secondary users (e.g. elders and carers respectively) provide implicit and explicit information when they interact with environmental elements. These elements can be physical objects (e.g. washing machine) or digital elements (e.g. web application on a computer).

When a user interacts with an element of the environment, certain valuable information can be generated and saved. This information is known as external PIA input. Every PIA input consists of a set of relevant data for analysis and later statistics as it was mentioned in previous sections.

Usually, in a home environment, PIA inputs are associated with events such as touching NFC tags or handling video clips with a tablet. Thus, when the user interacts with the element, a new PIA input is created and saved into the PIA analysis tool.

Examples of actions are the following: the user presses on the home button of the mobile app, the user touch an NFC tag with the NFC tablet, etc. Figure 30 shows an example of generation of a PIA input.
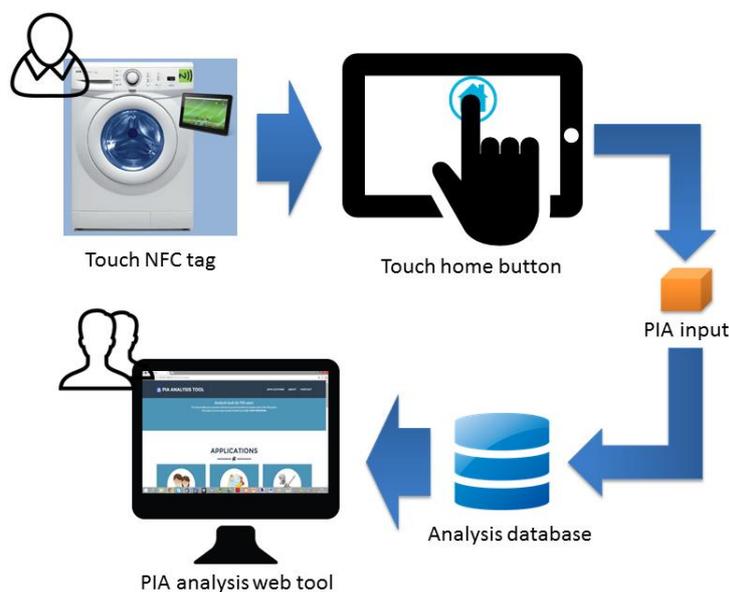

Figure 30. Example of PIA input creation.

In this sense, a video clip is displayed on the tablet device when the user (e.g., elder) touches an NFC tag attached to the washing machine. While playing the video, the user presses on the home button and a PIA input is created and sent to the PIA analysis database. Then, other users (e.g., carers and researchers) will be able to visualise that event at the PIA web tool.

6.1   Connection with other PIA apps. Introduction to the REST API

The analysis tool supports that external apps can send information about several actions (see section "PIA input gathering") by using this API, based on REST[5] protocol. Thus, it is possible to collect the PIA inputs corresponding to a specific user. Data of the PIA input are encapsulated into a JSON object like this:

```
{
  "acode":"AC13","iduser":"1234", "deviceid":"mobile003"
}
```

These data are sent via POST[6] method and automatically these are saved into the database. Then the information of the input will be available on the carer and researcher web applications.

7   Product web site

The software tools presented in this document are temporarily available at MAmI[7] server, here: http://161.67.140.37/PIAToolv16/web/

Note: *Only users with access privileges can use the whole group of functionalities of the PIA analysis tool (carer and researcher's side, and administration panel).*

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[5] http://rest.elkstein.org/
[6] http://www.w3schools.com/tags/ref_httpmethods.asp
[7] http://mami.uclm.es