Complete specifications of ICT services in an AAL environment

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Abstract Problems concerning services in an AAL kitchen environment are discussed. The complexity of their accurate specification is outlined. An example of implementation is described.

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1 Introduction

Despite the amount of resources made available for research and development in AAL (Ambient Assisted Living) and, in particular, for supporting people in activities connected to feeding (kitchen), at the moment the impact on the market of smart home appliances and their integration in a connected system is relatively little. According to the experience of the authors, after many years of activity in projects dealing with the kitchen environment, for example in the AAL Project FOOD [1] and in the Italian project D4ALL [2], the main reason is that what is offered to the potential consumers is probably not perceived by the users as very relevant with respect to their real needs.

In AAL, services are defined as a support to the activities carried on by people in their daily living at home. What is offered now, apart health care applications that however are not new, is only technology that can perform a specific task, such as standing up or falling detection, or fancy displays on home appliances to have information about their status or connections through the network e.g. to download recipes. On the contrary, what is necessary is that the home system is able to support activities

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that meet complex and composite needs, such as planning a person's diet, as part of a suite of services that seamlessly address all activities connected to feeding.

This situation is due to many reasons. Out of them, two are considered here. The first, discussed in detail in the paper, is that it is not possible to identify user needs to be satisfied with home-based services, if an accurate analysis in not carried out of the activities of people in their living environments, for example for feeding, and how they perform them. The details of these activities must be carefully identified to produce potentially useful services and then, in interaction with individual users, to find out what are, if any, residual difficulties they may experience to fulfil their goals and/or to use the services themselves, in order to introduce suitable adaptations and/or additional support (e.g. at the level of interaction).

The need of individuals of having specific adaptations of services themselves and/or additional supports is the second reasons for an insufficient uptake of the home technology. As a matter of fact, in the transition from AmI (see the ISTAG documents [3], i.e. Ambient Intelligence, to AAL, i.e. Ambient Assisted Living, the word "intelligence" has been forgotten. Available systems are not intelligent enough to be really useful, i.e. to be able to adapt themselves to the requirements of the single user.

2 Position of the problem

As a matter of fact, a lot of activity has been devoted to the adaptation capabilities necessary to match the service features to the different users' profiles, thus overcoming personal limitations, due to lack of user abilities and different contexts. Several studies are already available on static and dynamic adaptation, often cited as adaptivity and adaptability [4] [5]. However, from this perspective, a central role is assumed by the accessibility and the usability of the interface and to this concern laws, standards and guidelines are available [6]. Less activity has been carried out with respect to the adaptation of the functionalities of equipment and corresponding services.

Considering, for example, feeding, all basic necessary activities have been carefully identified in the WHO-ICF document [7]. However, the experience gained in the above cited projects, shows that the design of services in an assisted living environment requires an additional level of analysis. The definition of the main functionalities of the services, of the interface with the user and of its adaptation approach, is not sufficient. Most services, according to users' evaluation reports, do not reach the hoped satisfaction and acceptability level, mainly because they address trivial tasks or functionalities at a too general level.

With reference to the ICF classification, this means that the granularity of the classification of the activities is not sufficient to describe in the details how, for example, people construct a shopping list by collecting and harmonizing information about what they want to eat, what they have available at home, how frequently they are shopping and so on. The design process, as presently carried out, is relevant for the identification of the technical infrastructure, which is often the main concern of many efforts in research and development in the AAL environment, and the adaptation aspects of the human system interface, where a GUI implementation is generally assumed. The necessary complexity and completeness of the service, to be defined before any identification of adaptations of its functionalities to specific user needs or preferences, is often not sufficiently analyzed. The result may be a lack of real impact on the activity to be carried out by the user and therefore a difficulty at the market level.

Actually, the functionalities of services must be developed from the start at a level of detail able to cover most of the aspects concerning the considered human activity (see Fig.1). Otherwise, a service may be based on a powerful technical infrastructure and have an adapted user interface, without being really effective. The service provides advantages to the user only if it follows the activity normally carried out by her. This is why a service must not only be based on the identification of the necessary information flow. It must be compatible with and adhere to the user's habits. The service should be as much complete and coherent as possible even if complex. Part of the adaptation effort should be devoted to hide the complexity of the service to the user, when necessary.

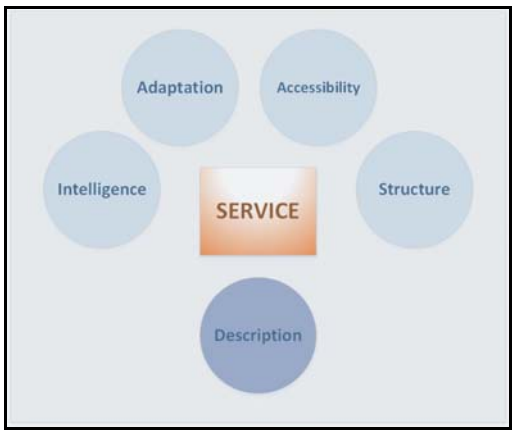

Fig. 1 Service components

3 Design Approach

Aspect related to a satisfactory description of an AAL service has been studied within a specific context in the D4ALL project, whose main objective is to create a platform for interoperability of ambient equipment and services and their adaptation to individual users. The platform is supposed to help in designing and implementing an inclusive and sustainable domestic environment adaptable and adaptive to the individual users both at the level of human-system interface and of the integration and cooperation of service functionalities. As a demonstration environment, the kitchen was selected. In order to start the process of service development, all offered services are grouped in four basic categories (macro-functions): Cookbook - dietary process (recipes), Diary - food preparation, Pantry – food management, and control of appliances. These categories collect most of the service related to the ICF domestic life activities [7], in particular activity d620 (Acquisition of goods and services) and d630 (preparing meals), because they collect the vast majority of services related to food preparation.

For each of the above basic categories, the component tasks and possible interconnections among them have been identified, trying to take into account, as much as possible, the real sets of operations that the user normally performs in her daily life activities. This approach tries to capture the fact that very often people do not perform single activities, but complex aggregations different activities.

Cookbook

This macro-function is at the level of interaction with general purpose information accessible from the service and available in principle to all interested users. It is not personalized. It contains recipes accessible through different selection criteria, e.g. the name of the recipe, the presence of an ingredient, the type of dish (e.g. pasta or dessert). For each recipe a list of necessary ingredients can be extracted and information about the availability in the pantry retrieved. Therefore, the cookbook function is connected with the pantry function.

Diary

This macro-function is available for every user registered with a specific profile. It represents the personal level of interaction with the cookbook. The diary contains the personal notes related with a recipe, including, for example, general comments or specific modifications of ingredients and their doses. This may include a list of already

used recipes, a list of recipes under preparation and, consequently, the shopping list. The shopping list can be directly derived from the list of ingredients of the recipes in preparation (components and quantity can be modified) or produced modifying an older shopping list or a list of normally bought items.

Pantry

This macro-function is in charge of the operations related to the acquisition and storage of food. It is divided in three storage space: a space at ambient temperature, a refrigerated space and a deep-frozen space. A search function is available that is able to produce a list of what is available with an indication of where in the pantry the element is available and the expiration date. At the moment, it is assumed that the pantry content is explicitly updated by the user after shopping and according to the use of the different items. However, it is foreseen that, due to the widespread use of new technological developments, as for example RFID tags, in the future the pantry content will be automatically updated. The list of items to be added to the pantry is a combination of elements coming from the recipes under preparation and elements explicitly introduced by the user according to her habits, the information about the conservation status and the expiry dates of the single items.

Appliances

This macro-function is in charge of the interaction with the home appliances. It gives information about their present status and control on all their functionalities. During the cooking activities it is possible to control the right execution of the recipe (e.g. temperature of the oven).

4 A case study - The example of a shopping list service

In order to understand the design process, reference can be made to a specific service, namely a service supporting the preparation of the shopping list. The first step in planning the service is obviously the study of how to replace the paper support with an electronic support, which can guarantee flexibility in use and accessibility by different categories of users, since they can take advantage of multimodal interaction. Then, the selection of the shopping-list components can be based on predefined tables of commonly used items presented as text or as a collection of icons, so favoring people with mild cognitive problems. However, a careful analysis shows that, in order to define the service, it is not sufficient to study the content of the list itself, but also how it is pro-

duced. Indeed, a person, when going to the market with the shopping list, has already carried out several activities that must be supported by the service.

Even an informal investigation of these activities gives an idea of the complexity of the necessary service and of the "intelligence" that should be introduced in it to be really useful and probably worth to consider the migration to an assisted environment. This investigation can be carried out with reference to a few short scenarios (sketchy descriptions of rea life situations). These scenarios are not assumed as design tools or supposed to be exhaustive of all possible situations, but are presented only as an attempt of showing the level of complexity which is requested in order to implement a service able to handle the larger number of aspects possible. They come from an evaluation of service requirements carried out by experienced users, in order not to cover every aspects of the service, but to improve their adherence to human activity.

1. Scenario 1: The user invited friends for lunch. Therefore, she selected some recipes, corrected the doses of ingredients according to the number of guests, and probably inserted some changes. For example, she replaced butter with oil, as her doctor suggested. She also introduced bookmarks on the kitchen book to come back fast to the pages of the selected recipes. She also checked the availability of ingredients, some of which she must use, since close to the best-before date. Shopping is also correlated to the food supply she likes to have at home. She checks the fridge, the freezer and the cupboard, since, for example, she generally uses fresh milk, but stores also some packages of long-life milk.

2. Scenario 2: The user decides to go for her weekly shopping. First, she has to check her food supplies, taking also into account the different best-before dates and, for example, the available vegetables in the fridge and in the freezer. She needs to assess what she needs during the week, taking also in account that some packages have already been partially emptied. Moreover, she wants to take into account the dietary suggestions of the doctor.

3. Scenario 3: The user is planning a dinner with her friends, but, at the same time, has also to take care of the weekly shopping. She has a list written the previous day, placed with a magnet on the fridge door. Now, she has to add new ingredients, after having found what product already available at home she can use.

4. Scenario 4: The user comes back from the market with all the items of the list, with the addition of other goods chosen while shopping, e.g. selected for their special price. Therefore, the list of what is available in the kitchen must be outdated.

The presented scenarios do not refer to different user's profiles, but to different situations. An effective service, in addition to be adapted to the different users' profiles, which include physical, cognitive, sensorial and motor abilities, must take into account the above described contexts of use. Therefore, it requires the development of functionalities more complex than editing text or listing icons, even if accessible.

5 Technical implementation

For the D4All project, an App(lication) on a mobile device with an accessible interface that implements the four macro-functions described above has been implemented. As a multiplatform environment, Cordova [8] is used and the solution is being tested on an Android device with O.S. Android 5.x and 6.01.

For the recipe-book, on the vertical left menu bar the App includes the list of recipes divided in five different courses: starters, first dishes, main dishes, side-dishes, desserts. As can be seen in the right part of Fig. 2, a list of ingredients is present, together with the quantity and an icon describing its availability in the pantry. An emoticon (happy - green, straight face - orange, sad - red) represents in a graphic form (color plus symbol) the presence, uncertainty and absence of the ingredient in the pantry.

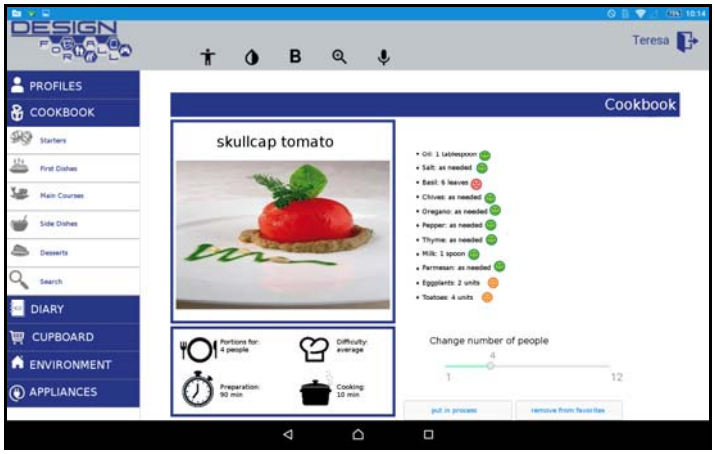

Fig. 2 Cookbook

Moreover, a picture with four basic comments about the recipe is provided: number of people, level of difficulties, cooking time, preparation. The number of people can be changed, and the system automatically adjusts the quantity of each ingredients and according to the availability, changes the availability icons. A “recipe in process” is foreseen, which implies the shopping of the necessary ingredients and the support for the real cooking

The Diary macro-function (Fig.3) includes a list of the used recipes (with the date of use), a list of recipes in preparation and the shopping list. The shopping list function can be used to create a new list or to add the ingredients of the selected recipe(s) to an already available list. Information about the quantities in the recipe and what is available in the pantry is made available to help people in deciding what she needs or wants to buy (it may be that she wants to leave a quantity of a necessary ingredient in the pantry), If the measurement units provided by the recipe and the ones used by the user are different, a conversion system is available, at least for a list of basic ingredients. Therefore, it is possible to modify the list of items, to change the quantity to buy or to decide to buy only what is not already in the pantry.

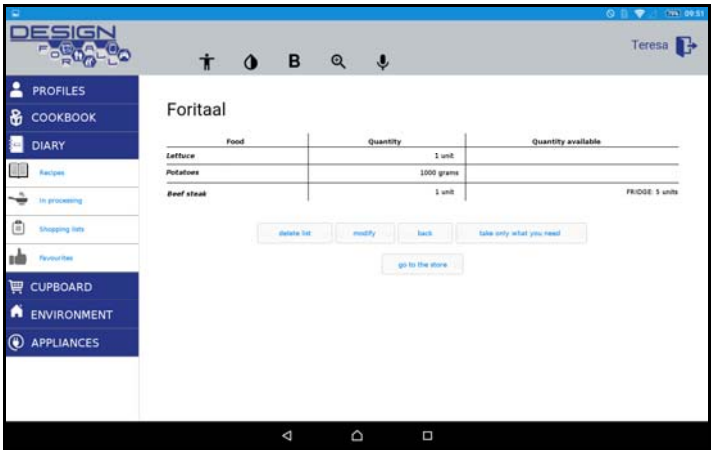

Fig. 3 Diary and shopping list

For the Pantry macro-function (Fig.4), the screen shot shows the three types of storage space: a space at ambient temperature, a refrigerated space and a deep-frozen space. For any item the quantity and the expiry date is shown. Buttons are used to control the lists: (i) to cancel an item, (ii) to add a new one, (iii) to confirm the addition or (iv) to cancel it.

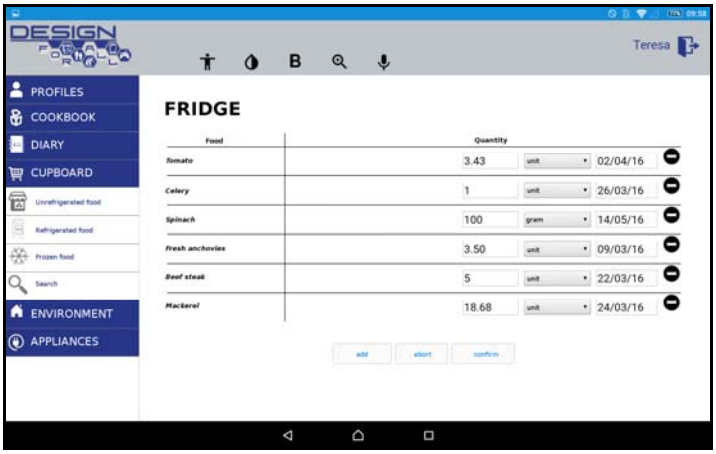

Fig. 4 Pantry

Even if it is assumed that in the future this operation will be automatic, presently the operations after the shopping are simulated, with the explicit addition of new items, even if they are not present in the previously produced shopping list.

For the macro-function control of home appliances in Fig. 5 the oven is used as an example. Some working parameters are shown and can be set. It is possible to choose a cooking program, the cooking temperature, and the switch-on time. Buttons to confirm commands or to correct them, if necessary, are available.

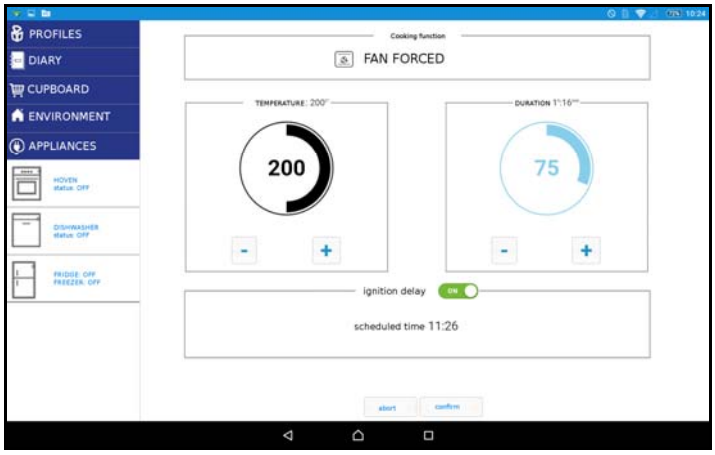

Fig. 5 Appliances

7 Future work

In this preliminary stage all functions have been arranged on the basis of the evaluation of experienced users. For the future a method to describe these activities in a systematic way, for example through state charts, id under study. With this system it is possible to represent both functionalities and interactions, in a way similar to the one carried out by people when they carrying out their activities. These representations could be simulated and compiled to perform an output in a programming language.

8 Conclusions

The implemented service can be the starting point for the introduction of different sets of functionalities aimed to help people in their daily activities, for example for the automatic production of shopping lists for periodic shopping, based on user habits. It can also include adaptations to individual users, such as the production of warnings related to the specific user health profile (for example diabetes) with automatic suggestions of alternative ingredients. Anyway, the basic concept is that, before studying and applying the adaptation process, it is very important to introduce into the system a sufficient level of knowledge and "intelligent" processing, which is able to emulate carefully the user activity. Otherwise, the adaptation process may result quite limited.

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