+TV4E: Delivering Information about Social Services for Seniors throughout TV

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Abstract. As a result of the ageing population process, societies, governments, and individuals deal with the emergence of new needs at several levels. Nowadays technological solutions are a reality in the daily life of senior citizens enhancing their quality of life, through the promotion of their autonomy and independence. Concerning the role that television plays in the quotidian of older adults, interactive television (iTV) platforms are becoming more relevant due to multiple factors, namely the interactive features it can provide. To quickly and easily access information on public and social services, iTV platform +TV4E was developed aiming to improve Portuguese seniors' info-inclusion. This chapter presents the steps inherent to the process of creating +TV4E. Alongside promoting Portuguese seniors' quality of life, it also aims to serve as a guide for similar projects.

1 Introduction

Ageing is one of the most challenging characteristics of the 21st century. Elderly life stage can be complex and distressing both for individuals themselves, families and communities if the conditions for an independent, active and healthy life are not ensured for as long as possible [1]. Concerning the multidimensionality inherent to the ageing process, it is essential to promote the cooperation and mobilization of agents from several sectors of society to enhance the elderly life's quality.

The "active ageing" paradigm holds that the ageing process must be accompanied by continuous opportunities in health, participation and security. In this regard, the elderly can also benefit in a large scale from technological developments [2]. However, the success rate of technologic solutions is highly related with the care taken in its development. This process should be based on the needs and expectations of potential end users, which is typically characterized by participatory design methods [3]. One of the key aspects to promote active ageing [2] and the individuals' quality of life is to obtain adequate information and be updated on the various aspects of life. Getting this information allows people to face challenges and make decisions in a conscious and

informed way [4]. Among other fields, an info-exclusion scenario of seniors is notori-
ous concerning the access to information about public services [5]. Thus, considering
the high levels of TV penetration in Portuguese elderly homes, it seems that allying
this technology with the information sending process of public and social content can
be a solution with great potential. In this context, the next section describes the
+TV4E project, in development since 2016 and currently at its final stage of imple-
mentation. It aims to send informative videos about public and social services through
an interactive television platform (iTV) to seniors, through videos that are dynamical-
ly introduced into the linear TV emission, which is locally paused during the display
of these videos and then resumed, as depicted in Fig. 1.

Fig. 1. Informative content inclusion in television programming.

Thus, this chapter presents the several phases that have been developed and which
have allowed the development of an iTV platform for the Portuguese elderly. It is
intended that this work can serve as a guide for other projects in this area as well as to
disseminate guidelines resulting from a field experience that may be an added value to
the scientific community.

2   +TV4E Project

The +TV4E project aims to support the Portuguese elderly in obtaining information
on public and social services quickly and easily through TV, reducing the probability
of an exclusion situation due to information deficits. Regarding this, an iTV platform
is under development and it will run in a low-cost Android Set-Top Box (STB) using
a regular internet connection. This infrastructure allows access to the same channels
that are offered in the Public Digital TV service in Portugal [6]. The developed plat-
form follows the operating flow illustrated in Fig. 1 and Fig. 2.

The +TV4E platform provides a splash screen (element 1 – Fig. 2) that is presented
each time that the user connects the STB. This "welcome" screen, that is active for 30
seconds, aims to guide the user concerning key areas of daily life, providing easy and
quick information which serves to contextualize the users about weather, time, date
and current season, as well as contacts for the nearest pharmacy and taxi service.
Afterwards, when a new information about a certain social or public matter is availa-

ble, a video spot is created and then injected into the linear television flow (element 2 – Fig. 2). The video can be visualized or not, according to the user preference. The audio-visual content presented to the user is created in an automatic way by a software developed according to a system architecture that will be presented later in this chapter.

The information presented in the videos is aggregated into seven previously studied macro-areas of interest, namely: (1) health care and welfare services; (2) social services; (3) financial services; (4) culture, informal education and entertainment; (5) security services; (6) local authority services and (7) transport services [7].

When the video is sent (element 3 – Fig. 2) and accepted by the user, the regular TV broadcast is locally paused and the video is displayed (element 4 – Fig. 2). Finally, the linear content is resumed (element 6 – Fig. 2) to the exact moment when the emission was interrupted to avoid content loss. When the video ends, a rating screen is displayed for 25 seconds in which the user is requested to express their opinion concerning their interest on the video, through a "like/dislike" system (element 5 – Fig. 2). The information gathered at this moment feeds a recommendation system that tunes the content to each STB according to the user preferences [8]. The rating screen only appears 50% of the times the video is viewed, minimizing possible problems in the user experience.

Additionally, all the informative videos sent to the STB are also available in a video library feature, accessed through the "0" key on the remote control. In this library, the user can review content already viewed as well as rejected or unseen videos [9].

Fig. 2. Flowchart elements that appear on the screen.

The +TV4E platform also provides two modes of presentation/visualization of the videos, as outlined in Fig. 3: "injection", where the user receives an overlaid notification informing that a new video is available and it will start in 15 seconds; or (ii) "notification", where the user only receives a notification, on the top of the screen, requesting the user's express wish to start the video display. At this moment, to accept the video, the user should press the "OK" key on the remote control. If the user does not execute any action, after 30 seconds, the notification retracts to the corner of the

screen waiting for instruction. After 4 minutes it disappears irreversibly if no action is taken.

Fig. 3. Video injection modes available.

Moreover, a mobile application for Android systems was designed (using a User Centred Design Approach), implemented and tested with potential end users. This app intends to give a more flexible access to the videos, not limiting the visualization solely to a home context.

Both in terms of the concepts inherent to the +TV4E project, and the components that compose it (graphics and sound elements) were implemented considering the opinions gathered with seniors, through a participatory design approach.

3   Project Execution Phases

One of the main goals of the +TV4E project is to develop a system with real impact on the lives of its potential users. In line with this, and according to the literature, it is important that products are built with potential end users, considering their needs and expectations [10]. Thus, participatory design methodologies were applied since the initial phases of the project. The guidelines of these methods were included in the procedures of creation, monitoring and approval of the available contents, design selection and presentation of the solution and decision on the product's functionalities [11]. The several phases conducted through the development cycle of the platform are depicted in Fig. 4.
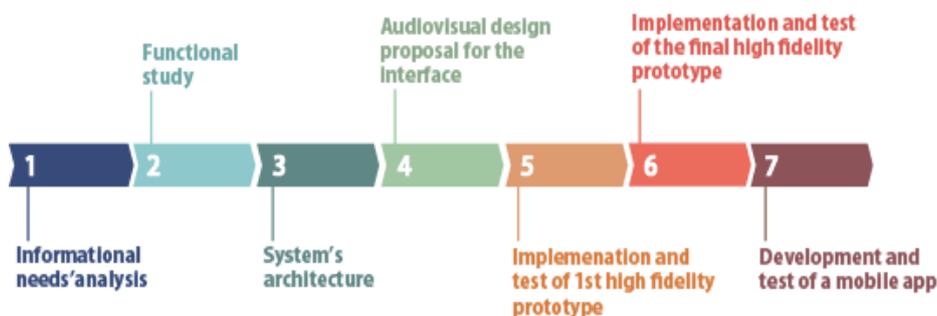

Fig. 4. Project execution phases.

Each phase consisted of several intermediate steps, in which different methodological techniques were applied. These phases took place in an evolutionary and sequential way, where the results obtained in each phase supported the development of the next one. However, the overlap of tasks' execution occurred several times, with the development of more than one task in parallel, which made some tasks take advantage of the results that started to emerge during the following activities [12].

3.1 Information Needs Analysis

In the initial phase of this project, a literature review was carried out addressing the challenges inherent to the population ageing and the responses available based on technological solutions [13]. It has been realized that these answers can represent valuable tools to foster high levels of integration in the community of older adults as well as improve their quality of life. Interactive television (iTV) platforms are some of these solutions, which benefit from the fact that TV is one of the most used media devices by the Portuguese elderly [14]. During this research, it was verified that there are some solutions to support and/or improve the quality of life of elderly in several life areas. "SmartSenior", eCAALYX, CogKnow, TAsisto and iNeighbour TV are some examples in this field [13].

With this basis information, the research team continued analysing the senior population's informative needs. For the implementation of this conceptual framework, databases of scientific publications were used as well as entities' reports with an interest in this subject. There are some studies, conducted in different countries, that analysed the informative needs felt by the elderly population. The main categories in which more information needs were identified are: health, finance/pensions/benefits, government policies, transportation, daily assistance services, housing, and current affairs [15–19]. Although there are no studies analysing this question in the Portuguese context, based on the concept of Services of General Interest (SGI), that supports elderly in their daily life activities to allow them to live independently, it seems there is a transversal trend at the informational level, namely in the field of health, financial, pensions and local policies [20]. Considering this, a first list of public and social services was defined, from which the Portuguese elderly seemed to require information concerning: health services; social services; financial services. Each one of these areas included a list of inherent social services, activities, and programs. After this initial definition, an interview was conducted with a specialist in public health promotion for seniors, who works with older people integrated in home context in Lisbon. At this stage, a preliminary version of the main information areas to be considered was defined: health services; social services, and financial services. Local services, listed in the literature review, were distributed among these three domains. Afterwards, a focus group with specialists (n=4) in the development of public policies in Portugal considered essential to add 3 other information domains to cover all the social activities and programs offered by the governmental authorities. In both data collection moments, a survey concerning the information sources (typically web addresses) to obtain information for each of the defined domains was applied. After the integration of these contributions, a second preliminary version of the services' list that

aroused interest in the seniors was defined, which was subsequently validated by a group of 25 seniors through the application of a survey. In this survey, participants were asked to rate each of the 7 macro-areas of interest and their respective services based in a Likert type scale to classify from 1 (unimportant) to 3 (very important). Most of the services listed were classified as important or very important, indicating that these domains can be considered as essential information for the daily life of the elderly. This process finished with the concept and taxonomy creation of Assistance Services of General Interest for Elderly (ASGIE).

Simultaneously to the execution of the first phase, the functional components of the +TV4E platform were defined to design an operational prototype and to base the future tasks by studying multiple solutions for each component.

3.2 Functional Study

After analysing the contents in which seniors felt the need to access, the next step consisted in defining a list of high-level functionalities to the +TV4E platform that should be included. Similarly to the previous phase, an exploratory literature review was conducted initially to understand seniors' expectations regarding digital platforms and iTV functionalities, as well as guidelines to develop digital and interactive platforms for older people. The analysis of international practices, together with the knowledge acquired by the research team, allowed the conception of a preliminary list of functionalities to implement in the platform. When a first version of the +TV4E platform was developed, the functional viability of the STB was tested. From this process, the first list of functional requires was submitted to an evaluation from experts with technical skills in iTV technologies and applications, through a focus group (n=4). This list specified the platform's requirements for each actor (senior, administrator; recommender mechanism and video generator which included WebCrawler, FFMPEG, and Text-to-Speech). Following the project's legitimization and presentation, the participants were given a list containing 25 functionalities and were prompted to classify each one's relevance. The list was based on a Likert type scale (0=not important; 1=important; 2=very important). Afterwards, all participants were invited to suggest any additional functionality or, if pertinent, to adapt/modify some of the proposed ones, to include them in the final list of high-level functionalities. This data collection moment, and after a technical analysis by the research team, was concluded with the final definition of the platform's high-level functionalities and the design of a system architecture.

3.3 System Architecture

Following the analysis of the most requested informative areas by seniors, alongside with the related web sources to extract information from, and the analysis of the functional components to be implemented in the platform, the platform's system architecture was designed. Fig. 5 is a high-level depiction of the system's architecture, which generates informative videos and broadcasts them to the iTV platform.
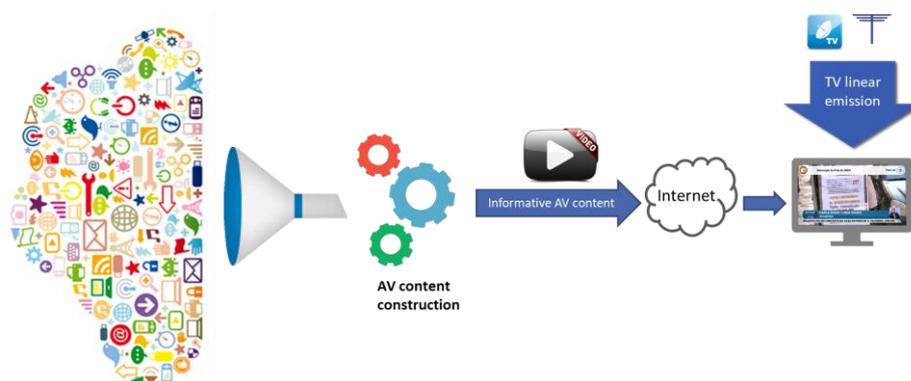
Fig. 5. Overview of content generation and delivery on +TV4E platform.

To produce the informative videos, a webcrawler developed by the +TV4E research-ers analyses textual content obtained from the defined informative sources (websites and portals previously associated with each ASGIE), in order to gather information to use in these informative videos[21]. The webcrawler is fully automated and its main task is to verify if there is new and relevant information available for the users. Being that the case, the system seeks for certain keywords within this information in order to filter in news pieces that are considered relevant for seniors. The used keywords were defined by the research team and were carefully chosen so that every senior's interest and needs are included.

Following the previously described proceeding, audio-visual content is automati-cally generated through a process in which the Automated Video Engine considers parameters such as a text-to-speech narration and visual elements (background colour, icon identifying each informative category, font type, and size, etc.) to include in the videos [22].

These videos are sent to the users every half an hour while using the developed iTV platform and according to a set of rules defined by the recommendation system (user's location and favourite topics). The received informative content is overlaid with the linear television broadcast, appearing a notification on screen asking the senior if he or she wants to watch the video. If so, the linear television broadcast is paused and resumed after the informative video is closed.

To design the referred architecture, it was first necessary for the development team to conduct a thorough technical analysis of several available tools, preferentially those which were free of charge. To create an automatic text-to-speech narration of the content three different alternatives were considered: IBM Watson, Ivona and ReadSpeaker. From all of these Ivona, currently bought by Amazon and renamed as Polly, was the chosen one, once it features Portuguese from Portugal language alterna-tive, its speech quality was very satisfactory and because, when considering the price-quality overall, it was the most economical solution [21]. Whereas, to produce and encode the videos FFmpeg was used, which has support for Javascript, the Automated Video Engine's main programming language [21].

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3.4 Audio-visual Design Proposal for the Interface

Creating innovative solutions with the participation of potential end users, both at design and evaluation stages is one of the most important design principles to develop effective solutions to citizens' lives [23]. In this sense, once the basic aspects of the system were defined, the establishment of the audio-visual elements of the interface was started.

Firstly, a literature review analysis was made concerning the main physical and cognitive modifications that happen during the ageing process of individuals, which can be reflected in problematic situations in the independent use of technological systems. Age-related changes contribute to a decrease of comprehension of the surrounding world, due to the central nervous system becoming slower at processing information captured by the sensorial channels, which causes some loss of information [24]. Visual changes (e.g. decline in the adaptability at different viewing distances and places with different lighting, loss of contrast sensitivity, loss of chromatic distinction, susceptibility to brightness) and hearing modifications (e.g. loss of sensitivity to pure sounds, difficulty in understanding speech, problems in locating the origin of sounds, problems in binaural hearing, increased sensitivity to sound intensity, and difficulty in processing sound information) profoundly mark the elderly overall performance and consequently affects their interaction with the use of iTV systems [22, 25]. Based on these changes and in order to identify the current trends in iTV applications for elderly, an analysis was made concerning the principles and design recommendations for the creation of the interface, audio-visual content and subsequent implementation of the informative videos on the +TV4E platform [22].

In the light of including end-users' participance during the development and design of a product, aspects related to typography, text, iconography, colours and sound elements were deeply analysed, and subsequently used to design and test a set of proposals, disaggregated by audio-visual component, with groups of seniors [22]. For example, to define the most adequate font type to implement in the platform, seniors were prompted to analyse various proposals of fonts in order to choose which one was the best for them.

For the accomplishment of the participatory design sessions, a partnership with two senior universities, from the Aveiro district, was established. This simplified the presentation of the project to the elderly as well as the dissemination of data collection moments held at their facilities. Throughout the several focus group sessions, different techniques were applied to the data collection [26], namely questionnaires, interviews, voting by symbolic process, election test and cognitive walkthrough [27]. During these moments, the audio-visual components put to test alongside with the participants were: i) textual elements (font type and size, analysis of the text on coloured backgrounds with variation of brightness and opacity); ii) sound elements (narrator gender and use of background music); iii) iconography (choice and/or proposal to reformulate a representative icon of each ASGIE, which identifies the main information area in a quick and intuitive way, based on three proposed icons developed for each ASGIE); and iv) colours (background colour that identifies each ASGIE).

Still in terms of designing the platform's interface, the video library feature was also a component that went through a process of co-design with end-users. Three differ-

ent proposals were presented to the participants consisting in three different navigation styles – horizontal, vertical or horizontal with a detailed information area of the selected video.

The number of participants included in the sample to establish each of these elements varied according to the individuals' availability, ranging from a minimum of four people to a maximum of 19 [9, 25, 28].

After collecting data on the several audio-visual elements, these were analysed by the research team, which resulted in some modifications according to the orientations and opinions of the seniors. After completing this phase, evaluating all these elements in a final moment was considered essential to validate the final versions of all components integrated in the platform, so that participants got a global idea of what the final product would look like. This led to a last focus group where a final evaluation was made alongside eight seniors. The elements tested in this moment were: text size; speech velocity; music perception; iconicity level; colour distinction; video's duration; reading synchronization with transitions and speed; screen's transitions; background images; background opacity and the information's interest [28]. The results obtained during this phase were crucial for the design of the interface and, consequently, for the course of the +TV4E project.

3.5 Implementation and Test of the 1st High Fidelity Prototype

After the audio-visual components were defined and tested with a group of senior citizens, the modifications established were implemented in the first high-fidelity prototype. Following the literature guidelines, it was considered essential to verify if the solution was in line with the real needs and expectations of potential users.

Thus, the next step of the +TV4E project was an observational study in a laboratory context (conducted under controlled conditions) with seniors, which allowed the analysis of the usability level, acceptance and utility of the prototype. In addition, it was possible to identify potential interface problems and aspects that could still be improved to increase the success rate when applying the system in a real context. The sample of this study was selected by convenience [29] and included 11 seniors integrated in a Day Care Centre of a Private Institution of Social Solidarity (IPSS) in Aveiro. After approving the collaboration request, the IPSS promoted a presentation of the project to its users and pointed out individuals that fulfilled the inclusion criteria defined by the +TV4E team, such as: being over 60 years; watching TV regularly; knowing how to read and being able to provide informed consent. All participants who took part in the study were volunteers. The objectives of the data collection were explained to them and everyone was given the opportunity to request additional information or to withdraw from the tests at any time. In addition, an information sheet was provided, and each participant was requested to sign and date an informed consent (inclusion criteria).

The user tests were divided in three phases: pre-test; test and post-test. In the pre-test, a sociodemographic questionnaire was applied to characterize the participants and analyse their television consumption habits. In the test phase, the participants were asked to perform a list of 14 tasks, previously defined and verbally explained by

the researcher. Simultaneously, an observer registered the participant's actions on a performance evaluation grid as well as reported critical observations/incidents during each task. Before starting the tasks, the researcher gave an overview about the platform and explained how the person should use some buttons (e.g. "0" key allows access to the video library, "OK" button to start and stop the display of a video). In the post-test phase, the Post-Study System Usability Questionnaire (PSSUQ) [30] was applied to analyse the usability of the prototype as well as a final questionnaire to assess the utility and general perception of the system.

This test was important to recognize the potential that this solution could represent for the life of an older adult. High levels of usability were achieved, but interface limitations have also been identified, particularly in the video library feature. It was found that in this feature, the layout of the videos with two horizontal lines showing a thumbnail of the videos and dividing them into categories of "seen" and "unseen" videos was not easy to understand and use. Then, and according to the collected contributions, some of the prototype components were modified and improved, in order to obtain the second version of the high-fidelity prototype.

Subsequently, according to the literature guidelines, the prototype was tested with a set of potential users in real use context. In order to collect relevant information to improve the platform and ensure functional suitability, accessibility and usability, as well as guarantee user satisfaction, field tests were carried out in home context with a group of potential end users. The inclusion criteria considered were: being over 60 years; watching TV regularly; live geographically close to the Aveiro area, to simplify the logistic of equipment installing and monitoring the experience. To take part in the field tests, participants needed to have a TV with High-Definition Multimedia Interface (HDMI) input to connect the provided STB, and an Internet connection that would foster the channels and the iTV application. These requirements have, in some way, restricted the diversity and size of the sample. Moreover, considering that the whole sample had a paid TV service, having a wide range of channels at its disposal, which were not provided by the STB was an extra restricting element. Due to legal constraints, the STB box only provided nine channels to the users, seven open Portuguese channels and two open Spanish channels. The sample was selected by convenience and it included four homes, with two individuals living in each residence. The eight participants (50% women and 50% men) used the prototype for five weeks.

During the first test moment, two research team elements went to the participants' homes and installed the STB, when possible on the TV used more regularly. Similarly to the in-lab tests, described above, information was provided concerning the study aims and data collection aspects, both written and orally. The sample was asked to sign an informed consent, answer a sociodemographic questionnaire for participants' characterization and then was explained how the platform worked. A user guide was provided with the main aspects that should be considered during the experience. During this time period, users were asked to regularly use the platform in order to identify all the elements related to the interface that hindered their user experience. The use of the platform was monitored through usage logs which were automatically saved by the system and telephone calls by the research team, to maintain frequent contact with the participants. These contacts aimed to keep the users engaged and motivated through the duration of the tests and allowed the research team to identify and record incidents

that happened over time. Ultimately keeping close contact with the sample was very important since it helped in finding and fixing software problems.

At the end of the fifth week, a final questionnaire and PSSUQ were applied to gather users' opinions on the system interface. It was also possible to identify and analyse technical limitations that were not detected during the development phase and laboratory tests, allowing the +TV4E team to address these gaps and fine-tune the final prototype. Additionally, it was possible to triangulate this analysis with the user-platform interaction registers, that allowed to identify other software faults and to define correction strategies, to adjust the final prototype of the +TV4E platform.

3.6 Implementation and Test of the Final High-fidelity Prototype

In the same way as the initial stages of a technology-based project's creation, it is also important that, at more evolved phases, field tests are conducted in a real-life usage context of a solution [10]. This way, more reliable results can be obtained, since the user is at its natural environment setting, within a context that is familiar to them and under conditions that are difficult to recreate in a laboratorial setting.

As referred in the previous subchapter, after testing the 1st version of the high-fidelity prototype of the +TV4E platform, the identified errors were solved, and the system was adapted according to the users' recommendations. These modifications were implemented which led to the final high-fidelity prototype, that was further put to test in a real usage context (domicile) with a group of potential end-users. Due to the difficulty in gathering people that would be available to test a system of this sort at their own homes, this testing phase relied in a non-probabilistic sample by convenience, which counted with a total of 21 participants. The sample included people aged over 60 years old, with availability to install an STB, a router 4G/Wi-Fi (which would guarantee Internet access), and if necessary, a television at their homes (in case they owned a TV without HDMI ports). This testing phase composed a total of five rounds, considering the research team only had four televisions available to set up at participants' houses, in case it was necessary. Each one of participants had the opportunity to test the system for two consecutive weeks, in which at the final of the first week, the video presentation mode was switched ("notified" vs "injected" – see chapter 2, Fig. 3). At each test round, the video sending mode for the first week, and consequently for the second, was alternated with the intent of avoiding biased and influenced results (e.g. the individual can be more compromised during the first week and, therefore, can refer preferring the sending mode of the first week).

The process followed during this phase was quite similar to the previously described, in the sense of obtaining comparable data over the several phases. It started with a face-to-face moment where the researchers met with the participants at their homes to install the equipment and explain them about the project and the value of their contribution to its development. At this first encountering, the participant was asked to sign an informed consent and to answer a brief sociodemographic questionnaire. Then, as the material was being installed, orientations were given to them on how to use the system. During the first week, the videos were sent through one of the two developed approaches ("notified" or "injected"), and at the end of this period, the

participant was prompted to answer a usability evaluation scale (PSSUQ), a User Experience evaluation scale (Self-Assessment Manikin – SAM), and a set of four questions regarding their usage experience. During the second week, the method of sending videos was changed and, finally, also in a face-to-face approach, the same usability and user experience evaluation scales were applied, as well as an interview for experience evaluation which included questions about their preference of sending mode, considered subjects, recommender system, etc. To avoid biased results in the final evaluation of injection modes, the sample was evenly split into two groups concerning the video presentation each week. While some of the users received videos through "injected" mode during their first week which was then swapped for the "notified" mode in the second one, the other users interacted the other way around, starting with "notified" mode, followed by "injected" mode. This strategy tried to ensure the minimization of influence on the gathered data, for example, users claiming their favourite mode was the last one they tested due to remembering it better.

By the end of the tests, a total of 1188 videos was sent by the system to the sample. Naturally, not all videos were viewed or rated. Among the total of sent videos, 665 were played. Considering the rating screen would appear with a 50% chance, within the total number of sent videos, 336 presented a rating screen, from which 106 were rated positively and 26 were rated negatively.

The results gathered from the final questionnaire showed that the platform was easy to use and revealed good usability, providing a pleasant experience to users when interacting with it. The frequency of sent videos per day was considered adequate, the remote control was simple to use and caused no problems. The video library and the splash screen were both positively evaluated. Nevertheless, and as negative inputs should never be neglected, some users referred to the narrator's voice as being a frailty in the platform and that the way of presenting the information could become monotonous, yet the aim of the platform and functionalities were recognized as interesting, useful and valuable to answer their informational needs.

3.7 Development and Test of a Mobile Application

After considering the platform's utility as stated by the participants of the previous studies, a mobile application was considered as an extension of the iTV platform. This application offers another way to access the platform's informative contents in a portable and simplified way. It features the user's video library as well as recommended content. The screens flow that appear while using the app are depict bellow (Fig. 6).
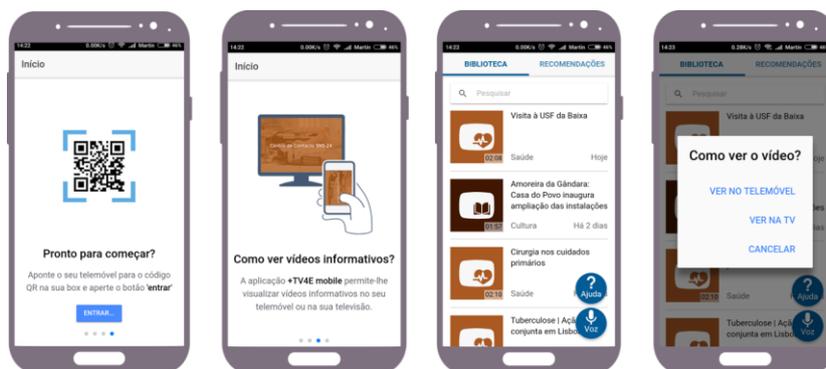
Fig. 6. Mobile application screens.

The +TV4E mobile application serves as a similar purpose as the video library present in the iTV application, allowing users to watch videos on-demand, thus giving control over which content the users want to see. Both in the library and the mobile application, the users are able re-watch videos they already saw or catch up on videos they missed or ignored while watching TV. Users can also watch suggested videos based on their usage of the platform. These suggested videos are provided by a recommendation system, developed under the +TV4E project [8], which is also used when choosing which video should be sent to each user. Furthermore, the mobile application gives users a search feature to find videos faster, allowing them to watch videos on their smartphones or on TV, and also interact with the iTV application through voice commands. Voice commands allow the user to perform a limited amount of actions, such as switching channels, changing to a specific TV channel given its name or number, and accessing the video library. This feature was implemented due to the rising popularity of voice assistants in the market, such as Siri, Alexa and Google Assistant.

Despite of being similar in terms of functionality, the mobile application greatly differs from the video library on iTV when it comes to its interface and user experience especially since it is developed for a different platform with a different interaction paradigm.

After the development of a first prototype of the mobile application, two test moments were performed with a limited number of potential users. This step is essential, in the authors' point of view, concerning that by engaging seniors in basilar development steps, it is easier to create a solution that better suits their needs, who often have difficulties handling newer technologies.

The test moments occurred both in under controlled conditions (n=5) as well as in home context (n=4). For both phases the participants should accomplish the following inclusion criteria: being over 60 years old; having a basic knowledge on how to use a smartphone since the application was being designed for users who already use a smartphone on a daily basis and being familiar with the +TV4E project. Both test phases aimed to evaluate key aspects of the interface and the layout of the application.

In the first test carried out, the participants were invited to perform a list of 14 predefined tasks through a cognitive walkthrough method, under controlled conditions.

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After the cognitive walkthrough moment, a SAM scale was applied to analyse the usability levels of the application, followed by a focus group (7 questions) in which the participants were invited to expose their opinions concerning the biggest issues of the proposed prototype while performing the cognitive walkthrough, as well as gather suggestions to fix these issues.

After analysing the gathered data and improve the mobile application concerning the opinions of seniors, field tests were carried out to evaluate the mobile platform in the real context of use (home context), with 4 seniors.

As in the previous phase, the objectives of the test were explained to the participants, and they were asked to sign an informed consent and to fill a socio demographic questionnaire. Afterward, the research team installed the necessary equipment for testing the platform, which involved hooking up the STB to a TV, installing a 4G router and the mobile application in the participant's smartphone. After explaining how the application worked the users were left to test it for a total of eight days, during which researchers frequently contacted the participants to monitor the experience. In the end of the experience, the material was removed and a semi-structured interview was applied to each participant, where they were encouraged to share any aspects they either liked or disliked regarding the mobile application. Afterward they were asked the same set of questions used in the previous focus group in order to gather some consistency in the results.

In general, between the first and the second test phases the usability levels clearly improved. In the SAM scale, a significant upgrading in the "Dominance" item was verified which can be attributed to the several improvements and fixes made to the first prototype, which aimed to address the biggest complains the users had regarding the navigation in the application. The "Pleasure" and "Arousal" items dropped, probably concerning that the sample included in the second round of tests did not maintain the same motivation throughout the duration of the field tests.

Globally, the results gathered with the other techniques suggested that the overall changes improved the usability of the mobile application.

4   Conclusions

The challenges and opportunities that come up with the ageing process, both at personal and community level, are drawing the attention of several sectors of society. Often, alternatives and solutions are being developed so that ageing is a stage of life marked by high levels of autonomy. This concern is reflected in the efforts undertaken to develop active ageing policies, products and services that promote quality of life in older age.

In the last decades, one of the answers to fulfil seniors' needs are the technological innovations that have appeared. Although this type of solutions only make sense if the final user is an active participant in the development solution process, as suggested by the co-creation process.

Additionally, societies' evolution is also proceeded by the sharing of knowledge, a key aspect in the development of innovative projects in academic and enterprise contexts. Distributing the information and knowledge obtained over an academic or cor-

poration project can represent an advantage for other research teams that operate in the same field or similar scientific areas. To confine the acquired know-how to solely those projects' members limits the results' utility and extent. Considering that the +TV4E project aims to develop a technological-based system for the Portuguese senior population, the present chapter intends to disclose which procedures and techniques were used on the several phases, as well as some difficulties that were faced that could potentially be transversal to other initiatives. The presented information is intended to inspire some guidelines for other projects taking the obtained results into account.

After the concept validation that was achieved through the life cycle of this project, it was also possible to conclude that this idea had potential to be explored in a commercial basis. In line with this, the team is already working hard to adapt the solution to the market, so that in a short time some individuals can benefit from this solution.

References

1. Walker, A.: Active ageing: Realising its potential. Australas. J. Ageing. 34, 2–8 (2015).
2. Kalache, A., Gatti, A.: Active Ageing: a policy framework. (2002).
3. Joshi, S.G., Bratteteig, T.: Assembling Fragments into Continuous Design: On Participatory Design with Old People. In: Scandinavian Conference on Information Systems. pp. 13–29. Springer International Publishing Switzerland (2015).
4. Bruce, H.: Personal, anticipated information need. Inf. Res. 10, (2005).
5. Amaro, F., Gil, H.: The "Info-(ex/in)-clusion" of the elderly people: remarks for the present and for the future. In: ED-MEDIA 2011–World Conference on Educational Multimedia, Hypermedia & Telecommunications. pp. 1024–1030 (2011).
6. ANACOM: TDT - O que precisa saber, https://www.anacom.pt/render.jsp?categoryId=326795.
7. Silva, T., Caravau, H., Campelo, D.: Information Needs about Public and Social Services of Portuguese Elderly. In: Proceedings of the 3rd International Conference on Information and Communication Technologies for Ageing Well and e-Health (ICT4AWE). pp. 46–57., Porto, Portugal (2017).
8. Campelo, D., Silva, T., Abreu, J.: Recommending Personalized Informative Contents on iTV. In: Adjunct Publication of the 2017 ACM International Conference on Interactive Experiences for TV and Online Video - TVX '17 Adjunct. pp. 99–103. ACM Press, New York, New York, USA (2017).
9. Mota, M., Caravau, H., Silva, T.: Designing a video library for senior users of iTV. In: Ferraz de Abreu, J., Guerrero, M.J.A., Almeida, P., and Silva, T. (eds.) Proceedings of the 6th Iberoamerican Conference on Applications and Usability of Interactive TV - jAUTI 2017. pp. 50–60. University of Aveiro, Aveiro, Portugal (2017).

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10. ISO: 9241-210 Ergonomics of human system interaction - part 210: Human-centred design for interactive systems. , Switzerland (2010).

11. Comissão das Comunidades Europeias: Envelhecer bem na sociedade da informação., Bruxelas (2007).

12. Caravau, H., Silva, T., Campelo, D.: A TV Interativa como veículo para infoinclusão dos seniores: um plano de execução de projeto. In: Sociedade Portuguesa de Engenharia de Reabilitação Tecnologias de Apoio e Acessibilidade (ed.) SUPERA. pp. 14–20 (2017).

13. Silva, T., Abreu, J., Antunes, M., Almeida, P., Silva, V., Santinha, G.: +TV4E: Interactive Television as a Support to Push Information About Social Services to the Elderly. Procedia Comput. Sci. 100, 580–585 (2016).

14. Marktest Group: Portugueses viram cerca de 3h30m de Tv em 2010, http://www.marktest.com/wap/a/n/id~16e0.aspx.

15. Barrett, J.: Support and information needs of older and disabled older people in the UK. Appl. Ergon. 36, 177–183 (2005).

16. Zou, C., Zhou, P.: Analyzing information needs of elderly people: A survey in Chinese rural community. Open J. Soc. Sci. 2, 109–115 (2014).

17. Edewor, N., Ijiekhuamhen, O.P., Emeka-ukwu, U.P.: Elderly people and their information needs. (2016).

18. Everingham, J.-A.J.A., Petriwskyj, A., Warburton, J., Cuthill, M., Bartlett, H.: Information provision for an Age-friendly community. Ageing Int. 34, 79–98 (2009).

19. Asla, T., Williamson, K., Mills, J.: The role of information in successful aging : The case for a research focus on the oldest old. Libr. Inf. Sci. Res. 28, 49–63 (2006).

20. Silva, T., Caravau, H., Campelo, D.: Information Needs about Public and Social Services of Portuguese Elderly. In: Röcker, C., O'Donoghue, J., Ziefle, M., Maciaszek, L., and Molloy, W. (eds.) Proceedings of the 3rd International Conference on Information and Communication Technologies for Ageing Well and e-Health. pp. 46–57. SCITEPRESS - Science and Technology Publications, Porto, Portugal (2017).

21. Silva, C., Campelo, D., Silva, T., Silva, V.: System Architecture for Personalized Automatic Audio-Visual Content Generation from Web Feeds to an iTV Platform. In: Abásol, M.J., Almeida, P., and Amárgos, J.P. (eds.) Communications in Computer and Information Science - Iberoamerican Conference on Applications and Usability of Interactive TV. pp. 3–17. Springer (2017).

22. Reis, L., Caravau, H., Silva, T., Almeida, P.: Automatic creation of TV content to integrate in seniors viewing activities. In: Abásol, M.J., Almeida, P., and Amárgos, J.P. (eds.) Communications in Computer and Information Science - Iberoamerican Conference on Applications and Usability of Interactive TV. pp. 32–46. Springer (2017).

23. Rosenberg, P., Ross, A., Garçon, L.: WHO Global Forum on Innovations for Ageing Populations. , Kobe, Japan (2013).

24. Tye-Murray, N., Sommers, M., Spehar, B., Myerson, J., Hale, S., Rose, N.S.: Auditory-visual discourse comprehension by older and young adults in favorable and unfavorable conditions. Int. J. Audiol. 47 Suppl 2, S31-7 (2008).

25. Silva, T., Caravau, H., Reis, L., Almeida, P.: Iconography's development for a seniors' iTV informative platform. Procedia Comput. Sci. in press (2017).

26. Coutinho, C.P.: Metodologia de Investigação em Ciências Sociais e Humanas. Almedina (2015).

27. Wharton, C., Rieman, J., Lewis, C., Polson, P.: The cognitive walkthrough method: A practitioner's guide. In: NIelson, J. and Mack, R. (eds.) Usability Inspection Methods. pp. 105–140. John Wiley & Sons, New York (1994).

28. Silva, T., Reis, L., Hernández, C., Caravau, H.: Building informative audio-visual content automatically: a process to define the key aspects. In: Ferraz de Abreu, J., Guerrero,

M.J.A., Almeida, P., and Silva, T. (eds.) Proceedings of the 6th Iberoamerican Conference on Applications and Usability of Interactive TV - jAUTI 2017. pp. 132–143. University of Aveiro, Aveiro, Portugal (2017).

29. Carmo, H., Ferreira, M.: Metodologia da investigação–Guia para Autoaprendizagem. Universidade Aberta, Lisboa (2008).

30. Lewis, J.R.: Psychometric Evaluation of the PSSUQ Using Data from Five Years of Usability Studies. Int. J. Hum. Comput. Interact. 14, 463–488 (2002).