FinJeHeW Finnish Journal of eHealth and eWelfare

SCIENTIFIC PAPERS
VERTAISARVIOITU
KOLLEGIALT GRANSKAD
PEER-REVIEWED
www.tsv.fi/tunnus

Easy-to-use TV guide for older people

Konsta Rantakangas, Raija Halonen

M3S, Faculty of Information Technology and Electrical Engineering, University of Oulu, Finland

Raija Halonen, PhD, M3S, Faculty of Information Technology and Electrical Engineering, University of Oulu, PO Box 8000, FI-90014 University of Oulu, FINLAND. Email: raija.halonen@oulu.fi

Abstract

The increasing number of the older people is a global phenomenon, and this challenge is also seen in Finland. With the vast development of web-based services, the older people have faced a need to adapt new services as the traditional 'at-desk' services are getting rarer and less available. Due to their special needs compared to younger generations, the older people have more challenges to learn and use the modern services available to them. This situation has produced additional requirements to be noted when designing new solutions for the increasing amount of older user groups. The current paper presents an example of such a targeted solution with building a web-based solution for the older people to see what is shown on TV. The solution consists of a mobile application, and special attention was paid on the requirements related to the older people and their age-related restrictions. The output is a prototype, which was built by applying design science research. The age-related requirements for the solution were based on a literature review, and the prototype was planned to be used by the older people watching TV, having enough skills to use a mobile phone, and a television device that was controlled by a remote device.

Keywords: aged, web-based, support

Introduction

The purpose of the current study was to develop information and communication technology (ICT) - based mobile application to assist older people stay relaxed and feel well despite lack of potential face-to-face meetings with their peers or relatives, due to what ever reasons.

Loneliness has been identified as an issue among frail older people, and its relation to healthcare consumption has been reported to be clear. This was verified e.g. by Taube et al. [1] in their study that focused on loneliness, health-related quality of life, and health complaints.

Decreasing face-to-face meetings leads to more loneliness among people who otherwise would spend time with their friends and relatives. One group of these people are the older people who have avoided meeting other people and participating in activities planned for them more than normally. Often such distance occurs when the older people lose their spouses (see e.g. Dykstra et al. [2]). Keeping this in mind, the current study paid special attention to the older people and their

often limited skills to use state-of-the art devices and web-based services.

Today, web-based services are used in most premises and houses. Several reasons are seen in the background of the current way of living. New technologies have enabled new ICT to be used in everyday life of individuals [3,4]. Even if younger generations and middle-aged people already have been using modern web-based services, many older people have seen it challenging to learn new practices and to perform compulsory or necessary tasks especially if the service providers don't offer the same at desk -services anymore [5,6].

Earlier studies [7,8] have shown the importance of applying proper ways of e.g. fonts, colour, pictures, and navigation in the web-based services. Like any younger users, also older people benefit from careful planning and development done by designers who can pay attention to usability also from the elderlies' point of view [9,10].

The current study focused on the identified research gap of problems related to lacking solution for older people to apply versatile and multifunctional applications related to web-based services. As an example of a solution, a web-based mobile application was designed to assist and help the older people to see what kind of programmes are offered on the national television channels. To define the application, a research question was posed: What kind of a mobile TV guide is suitable for older people? To construct the application, design science research (DSR) was applied.

As the main contribution of the study, the development of a mobile application is described to act as a prototype, which was further to be tested by older people in their living environments.

The paper continues as follows: First, earlier knowledge is briefly reported. Then, the research approach is described. After that, the main section about building the artefact is reported to guide interested people to apply the same process when building their own tools to make it easier for older people or others who could benefit from the application. The paper ends with discussion on top of earlier knowledge and conclusive words.

Earlier knowledge

Globally, ageing is increasing rapidly, and it brings challenges on societies to manage wellbeing [11]. Loneliness is one concern among older people, it is more common among those who live in their private homes instead of sheltered housing, and it should be reduced to add wellbeing [12].

Keeping in mind that ICT has been ever more important in people's everyday lives where web-services' integration has been increasing ever more [13], the role of versatile web-based services is seen more significant than ever before [14]. In Finland, there already have been efforts to offer guidance and education to the older people to utilise web-based services. More time and guidance is required to ensure that the older people can adopt the new ways to manage the services they need [15].

Also, older living in sheltered accommodation and especially their ways and skills to utilise ICT-supported services have interested researchers. For example Nygård and Starkhammar [16] studied older people who suffered from dementia. They noted how the living environment required several numerical codes to be used when living everyday life in the premises.

Despite many disabilities and other issues people might suffer from, web-based technology is ap-

plied in everyday life and social interactions nowadays [17]. Sayago and Blat [5] pointed out the accessibility barriers that can hinder older people to apply web-based services, which require users to remember several steps, actions and functions that are needed to get the desired output.

The role of watching TV has earlier been discussed among nursing professionals focusing on older people and their risks of getting more passive. On the contrary, watching TV has later been seen important especially from the viewpoint of adding activity and engagement among the older people [18]. Already earlier Dykstra et al. [2] pointed out that loneliness can be a serious issue and is often caused by increased problems with health or loss of spouse. Loneliness can lead to getting more passive and seeking for more health care services [1].

Mikkola and Halonen [19] reported how older people living in their private homes but benefiting from services offered by sheltered accommodation in their neighbourhood perceived social media. In their study, twelve individuals were interviewed and asked about their familiarity with personal computers, social media applications and mobile phones. Their study revealed that a few of the informants regretted not to learn earlier how to interact via social media, while others used e.g. Facebook actively and kept relationships warm also without meeting their relatives. Interestingly, one informant revealed that her spouse had encouraged her not to learn new technology. One can assume that there are several married couples with spouses that do not fancy ICT similarly.

Castilla et al. [20] conducted a study where they designed and evaluated a multi-application system for the older people. In their study they focused on evaluating aspects such as iconography and navigation. Castilla et al. pointed out that the older people are rarely familiar with navigating web pages and this often poses a problem in their usage of web-based services, and they concluded that linear navigation, as in books, makes navigation more comfortable for the older people users.

According to Majumder et al. [4], state-of-the art technologies are increasing in private homes, and available also for older people. However, smart homes consisting of wide range of sensors and wireless devices are not yet accessible for older people in general. Majumder et al. [4] pointed out that more research is required to understand how older people living independently can comprehend the possibilities and risks that may be connected with wide monitoring and data sharing enabled by Internet-of-Things.

Recently Rantakangas and Halonen [8] focused on special needs of older people as users of web-based services. In their literature-based study they identified challenges related to e.g. sight, hearing, sense of touch, slowness, and cognitive skills. To emphasise the importance of understanding the significance of their findings, they summarised five features (see Table 1) to be noted when designing for older users. They also concluded that as the older people get used to ICT-related experiences, the experiences will encourage and help the older people to adopt new skills and different kinds of web-based services.

Based on their study, Rantakangas and Halonen [8] introduced seven building blocks (‘no animations’, ‘less graphics’, ‘avoid technical terms’, ‘no haptic touch’, ‘easy guidelines’, ‘test of experience’, and ‘custom user settings based on pre-entrance questionnaire’) to be used by especially those developers who design and develop web-based applications to be suitable for the older users. The current implementation (see Chapter 4) was built according to the building blocks.

Table 1. Required features for older people users.

Feature	Description	Cause
Text-based pages	Text-based pages consist mainly of text elements with large font and only little graphics.	Older people have found text-based web services more pleasant due to weakening sight.
Icon feedback	Icon feedback is a visual feedback, for instance from an interactive component like a button to visualise a successful execution of a functionality.	Haptic touch is not an option due to weakened sense of touch.
Double-click to one-click element	Double-click element requires two fast repeated clicks in order to execute its functionality.	Double-click element should be avoided due to loss of motoric skills.
Simple outlook	Simple outlook means that web-based service looks sophisticated and has overall simple design that highlights the essential elements.	Small buttons and too many graphical elements can confuse the user of the service.
Axiomatic appearance	Axiomatic appearance means that the web-based service has self-evident user interaction elements.	It is possible that the user does not have a lot of earlier experience of web-based services.

The study

Research approach

This section briefly describes the chosen research method. Design science research (DSR) is identified as a practical method especially in research cases with concrete artefacts such as improved user interface, added functionality or prototypes of such [21]. In the current case, the artefact was to answer the research question *"What kind of a mobile TV guide is suitable for older people?"*. According to March and Storey [22], information technology (IT) artefacts should improve business technology in organisations, and later Baskerville et al. [23] pointed out that DSR should pay attention both on the technological point and theories.

To assist researchers to apply DSR, Hevner et al. [21] provided seven guidelines to be noted and followed in the work. Those guidelines were named as Design as an Artefact (a new application); Problem Relevance (more suitable for older people); Design Evaluation (verifying relevance);

Research Contributions (new knowledge, new application for older people); Research Rigour (design science research approach with implementation cycles); Design as a Search Process (iteration, benefit from earlier knowledge); and Communication for Research (reporting of the construct).

Implementation of the artifact

In this case, the TV program guide was intended especially for the older people to showcase how older people can use a web-based application that is planned for them. Therefore, the age-related restrictions as well as the requirements posed by the experience level of the user group needed to be paid close attention, especially during the design process.

The TV program guide was selected as the application to be developed since the older people usually are active consumers of TV content. A step from *a traditional program listing in a journal* or a newspaper to a web-based program guide was considered reasonable since the format of program listings is typically similar regardless of the platform. Mobile devices were chosen as the platform for the web application.

The development of the TV program guide was made through five iterative development cycles. The objective was to build one, simplified prototype including only the essential elements of a TV program guide. During each cycle, the software was developed further towards building blocks introduced by Rantakangas and Halonen [8]. At every iteration phase, the prototype was inspected to spot issues that could be enchanted towards the building blocks and recommendations. Development of the TV guide was made in small steps in order to facilitate the development process since smaller increments are easier to handle.

When it was clear that there could be some improvements made in the next iteration cycle, the next cycle was started to make the design follow the building blocks more accurately. After five iterations, the final version of the TV guide was produced. After producing the final design, the prototype was built from the fifth layout into a web application by using the ReactJS library.

The purpose of the development process was to create a prototype. The modifications made to develop the prototype on each cycle are described separately for each prototyping image. The modifications made to develop the prototype on each cycle is described next.

Figure 1. First, second, third, and the fourth version of the prototype.

First prototype

The first prototype image (left in Fig. 1) consisted of basic elements (weekday, date, channel, time, program). The first prototype already followed some building blocks for designing web-based services for the older people.

Colours on the web-based service were to avoid confusion and overall visual distraction. Interactive elements were designed to be large enough from the start. As seen in Figure 1, the first prototype had two buttons - (<) and (>) - that could be used to change the date. Program list was meant to be scrolled down and up to change TV channels.

TV programs for each day and channel were listed line by line so that the user could at first glance only see the channel with the identification number of one, in this case YLE TV1. On this version, the programs were listed starting from 4AM and ending at 4AM on the next day.

Second prototype

In the second version of the prototype (second left in Fig. 1), the heading (“Ohjelmaopas”) was removed as not compulsory. Also, the top of the date box was separated to indicate that this element was a separate functional component.

An indication of whether the programs on the TV guide are from the ‘current day’, ‘next day’ or the ‘day after tomorrow’ was given below the date.

On this development cycle, separation between TV programs in the listing was made by adding extra spacing every three hours. Thus it was easier for to read the programs as there are some visual anchors on the listing.

Third prototype

On the third version (third left in Fig. 1), more space for the actual buttons were added to make the buttons appear larger and easier to press.

Due to slowness and decrease in sight and cognitive skills of the older people, excessive scrolling on sites was to be avoided, and thus the third prototype version introduced the channel selection button (light blue button below the date box). With channels selected from the submenu, there would be no need to scroll excessively to change TV channels.

In addition, on the top of the page, the text was centre-oriented for the date and the channel selection elements. To improve the overall design and clarity, the channel name and the three-hour time dividers were changed to be aligned to the middle as well. This was done to test whether the user experience got any better with new component placing.

Fourth prototype

In the fourth cycle (right in Fig. 1), the channel menu button was removed to get a lot of space for the actual program listing. The biggest change in this development cycle was the addition of previous and next channel buttons. The buttons for the back and forth channel navigation would be the same components as used to navigate the date, and the buttons were located in line with their corresponding fields.

On this prototype, the text alignment was moved back to the left for the three-hour time dividers to make reading and following the times easier.

The fourth version also introduced a feature that highlights the current program that was airing on the selected TV channel. The current program was underlined to make it more obvious. The black underline with the red progress bar also had the functionality to show how far the program has progressed.

Final prototype

To build the final prototype, still a few modifications were made to improve user experience for the older people when using this web-based service.

Figure 2. The final prototype.

To achieve maximum space for the actual content (TV programs), and partially due to space restrictions, the current program name was modified to be only on the same line as its starting time.

On the fourth prototype, there was a new feature added which allowed the user to see how far the current program had reached. In consideration of contrast sharpness, in this last version of the prototype that colour combination was replaced with red and white (Fig. 2).

Interactive components

The designed TV program guide included only few interactive components that the user could interact with. Those interactive components were buttons and the purpose of those was to change the date and the channel to the next or the previous one.

From the first prototype to the final prototype, the buttons were always the same size. During the cycles, only the placement and the amount were changed. The colour and contrast ratio of the buttons were chosen to be seen easily but not be too distractingly bright or colourful.

There were situations where all the buttons were not visible. When the user entered the TV guide, only the current day's programs were shown. Because this web-based service's primary users were the older people, a visual approach was taken, and a visual icon feedback was utilised to indicate a successful button press. Successful registered button press was indicated by high contrast change in button colour (colour inverse) and with an animated circle around the button to show feedback (Figure 3).

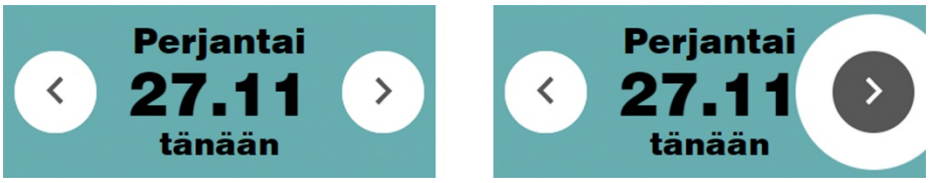

Figure 3. Icon feedback.

Implementation

This section covers fundamental information about the implementation of the TV guide. The TV guide was built using ReactJS that is a JavaScript library meant to be used to build user interfaces.

First steps towards the finished product was to take the final prototype layout and create interactive components. The button component was created, and icon feedback was implemented for the button component. Next, a basic layout structure was created to define where all the components should be placed. Measurements were taken directly from the prototype layout to the actual code. After that, rest of the smaller components were implemented, including text boxes for the date as well as the channel name component. Also, the components for the program listings and the three-hour time dividers were created.

After successfully implementing all components, the components were placed on to the web-service's layout just as they were in the final prototype image. Functionality was added for the buttons to be present when intended. Finally, the program listings were fetched by using REST API calls and the program information was listed using the program listing components.

Results

This section presents the final construct (Fig. 4). The building blocks by Rantakangas and Halonen [8] were applied in the implementation. An evaluation of how this output follows the building blocks is given next, followed by a report of how this study followed design science research.

Figure 4. The final product.

Evaluation against the building blocks

One of the building blocks introduced by Rantakangas and Halonen [8] was that developers should not *use animations*. This web-based service does not have animations except to indicate that a button press has been registered by the system successfully. In this case, the animation is helping the user realise that the growing white circle around the button occurs after a successful button press. It was thought that it is more important to clearly show the good icon feedback than to avoid animation completely.

One of the building blocks stated that *less graphics* should be used and that is why overall simplicity was pursued in this web-based service. For instance, the TV stations do not have their logos visible (see Fig. 4) because the user might not identify all the channel logos. It is clearer to use only one component type to indicate the selected channel.

The TV guide does not include any technical terms due to its simplicity. So, the guideline that recommends *not to use technical terms* was realised.

Easy guidelines were considered for this TV guide project. The placement of the components was kept in a systematic grid for simplicity. Excessively colourful components were avoided, however text colour and background colour contracted each other. In addition, text size was large enough and font weight of the text was bolded.

The first prototype was based on earlier studies, and actual users were not involved in the design process of the artifact. Thus, the building block

suggesting *a test of experience* for the potential users was not applied.

Verifying design science research

The seven guidelines introduced by Hevner et al. [21] were applied during this research project. This process produced viable artifact in the form of a mobile web-based service. A solution to the problem of developing a web-based application for the older people that considers the requirements posed by the user group was produced. The artifact was evaluated based on the building blocks defined by Rantakangas and Halonen [8]. Clear and verifiable contribution was offered in the field of designing web applications for the older people and efforts to construct and evaluate the artifact were thorough. An effective artifact was searched by iterative design and multiple iterations of prototype models. The results of the study have been presented in a matter that benefits audiences such as developers, designers, and managers.

Discussion and conclusive words

The current study focused on the older people and their special needs when producing an application designed for them. The construct was to be piloted by older people in the later phases.

The intended purpose of this study was to create a web-based TV guide suitable for older people by using DSR. A web-based application was a realistic choice due to widely spread Internet-connections at homes (see Majumder et al. [4]). The evaluation was theoretical and was based on building blocks introduced by Rantakangas and Halonen [8].

Based on earlier knowledge, loneliness increases especially when people get older [1]. Loneliness is more common among older than younger generations, and this loneliness is often caused by increased health issues or loss of spouse [2]. Contrary to what has been suggested earlier, watching TV adds activity instead of making older people more passive [18]. This finding lead to the idea of building a mobile application that assists older people to easily see what is offered in the TV channels and choose their favourite program with the application.

The idea of the construct was based on earlier knowledge that revealed the challenges the older people meet if they are not familiar with state-of-the-art applications and devices [5-7]. Special attention was paid on the user interface and its usability as guided by e.g. Becker [9] and Newell [10]. On the other hand, it was also understood that older people can be active web-based users with the skills they have [19].

The navigation of the application was implemented in a linear fashion (see Castilla et al. [20]). Changing channels and dates feels like browsing a book, which was planned to bring familiarity into the application for the older people, and to make navigation through program listings easily understandable.

In all, the developed web-based mobile application is expected to be well received by the older people as soon as it is available and accessible for them. In the future, the application is planned to be analysed from its usability point of view in the hands of the older people.

Acknowledgements

The constructive comments given by the anonymous reviewers made it possible to finalise a compact research report.

Conflict of interest

No conflict of interest to inform.

References

[1] Taube E, Kristensson J, Sandberg M, Midlöv P, Jakobsson U. Loneliness and health care consumption among older people. Scand J Caring Sci. 2015 Sep;29(3):435-43. https://doi.org/10.1111/scs.12147

[2] Dykstra PA, van Tilburg TG, de Jong Gierveld J. Changes in Older Adult Loneliness: Results From a Seven-Year Longitudinal Study. Res Aging. 2005;27(6):725–47. https://doi.org/10.1177/0164027505279712

[3] Huttunen HL, Klakegg S, van Berkel N, Visuri A, Ferreira D, Halonen R. Understanding elderly care: a field-study for designing future homes. In: Proceedings of the 19th International Conference on Information Integration and Web-based Applications & Services. 2017. p. 390–394. https://doi.org/10.1145/3151759.3151835

[4] Majumder S, Aghayi E, Noferesti M, Memarzadeh-Tehran H, Mondal T, Pang Z, et al. Smart homes for elderly healthcare - Recent advances and research challenges. Sensors (Basel). 2017 Oct 31;17(11):2496. https://doi.org/10.3390/s17112496

[5] Sayago S, Blat J. About the relevance of accessibility barriers in the everyday interactions of older people with the web. In: Proceedings of the 2009 International Cross-Disciplinary Conference on Web Accessibililty (W4A). 2009. p. 104–113. https://doi.org/10.1145/1535654.1535682

[6] Pollitt C. Technological Change: a central yet neglected feature of public administration. The NISPAcee Journal of Public Administration and Policy. 2010;3(2):31–53. https://doi.org/10.2478/v10110-010-0003-z

[7] Pirhonen J, Lolich L, Tuominen K, Jolanki O, Timonen V. "These devices have not been made for older people's needs"–Older adults' perceptions of digital technologies in Finland and Ireland. Technol Soc. 2020;62:101287. https://doi.org/10.1016/j.techsoc.2020.101287

[8] Rantakangas K, Halonen R. Special Needs of Elderly in Using Web-Based Services. In: Cacace M et al. (eds) Well-Being in the Information Society. Fruits of Respect. WIS 2020. Communications in Computer and Information Science. 2020;1270:50–60. https://doi.org/10.1007/978-3-030-57847-3_3

[9] Becker S. A Study of Web Usability for Older Adults Seeking Online Health Resources. ACM Transactions on Computer-Human Interaction. 2004;11(4):387–406. https://doi.org/10.1145/1035575.1035578

[10] Newell AF. HCI and older people. In: Goodman J, Brewster S (eds). HCI and the Older Population. Proceedings of the workshop on HCI and the Older Population, September 2004. p. 29-30

[11] Mitchell E, Walker R. Global ageing: successes, challenges and opportunities. Br J Hosp Med (Lond). 2020 Feb 2;81(2):1-9. https://doi.org/10.12968/hmed.2019.0377

[12] Eloranta S, Arve S, Isoaho H, Lehtonen A, Viitanen M. Loneliness of older people aged 70: A comparison of two Finnish cohorts born 20 years apart. Arch Gerontol Geriatr. Sep-Oct 2015;61(2):254-60. https://doi.org/10.1016/j.archger.2015.06.004

[13] Hart TA, Chaparro BS, Halcomb CG. Evaluating websites for older adults: adherence to senior-friendlyguidelines and end-user performance. Behaviour & Information Technology. 2008;27(3):191–199. https://doi.org/10.1080/01449290600802031

[14] Williams D, Alam MAU, Ahamed SI, Chu W. Considerations in designing human-computer in-

terfaces for elderly people. In: 2013 13th International Conference on Quality Software. IEEE; 2013. p. 372–377. https://doi.org/10.1109/QSIC.2013.36

[15] Naumanen M, Tukiainen M. Guiding the elderly into the use of computers and Internet–Lessons taught and learnt. In: Proceedings of cognition and exploratory learning in digital age. IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2007). 2007. p. 19–27.

[16] Nygård L, Starkhammar S. The use of everyday technology by people with dementia living alone: Mapping out the difficulties. Aging Ment Health. 2007 Mar;11(2):144-55. https://doi.org/10.1080/13607860600844168

[17] Hardey M. ICT and generations constantly connected social lives. In: The Good The Bad The Challenging. Proceedings of the COST conference 13th-15th May, 2009, Copenhagen, Denmark. Paper 185.

[18] Östlund B. Watching television in later life: a deeper understanding of TV viewing in the homes of old people and in geriatric care contexts. Scand J Caring Sci. 2010 Jun;24(2):233-43. https://doi.org/10.1111/j.1471-6712.2009.00711.x

[19] Mikkola K, Halonen R. “Nonsense?” - ICT perceived by the elderly. Conference paper. In: European, Mediterranean & Middle Eastern Conference on Information Systems. EMCIS; 2011. p. 306–31.

[20] Castilla D, Garcia-Palacios A, Breton-Lopez J, Miralles I, Baños RM, Etchemendy E, et al. Process of design and usability evaluation of a telepsychology web and virtual reality system for the elderly: Butler. Int J Hum-Comput St 2013;71(3):350–62. https://doi.org/10.1016/j.ijhcs.2012.10.017

[21] Hevner AR, March ST, Park J, Ram S. Design science in information systems research. MIS quarterly. 2004;28(1):75–105. https://doi.org/10.2307/25148625

[22] March ST, Storey VC. Design science in the information systems discipline: an introduction to the special issue on design science research. MIS quarterly. 2008;32(4):725–30. https://doi.org/10.2307/25148869

[23] Baskerville R, Baiyere A, Gregor S, Hevner A, Rossi M. Design Science Research Contributions: Finding a Balance between Artifact and Theory. J Assoc Inf Syst 2018;19(5):358–76. https://doi.org/10.17705/1jais.00495