

Design and Assessment of User Interface Optimized for Elderly People. A Case Study of Actgo-Gate Platform

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Abstract: In much of the world, particularly the developed world, there's a growing aging population. Our work focuses on user experience and its impact on user interface design of web-based applications for elderly people. The paper presents the set of aging-centered user interface design guidelines. An initial collection of guidelines was first developed through an extensive review of the human-computer interaction and aging-oriented literature and through applying a series of classification methods. Then the Authors proposed an assessment framework, which could be used as an universal tool to evaluate the web-based system according the user interfaces dedicated for elderly people. The detailed guidelines were grouped into 7 categories which were granted with appropriate importance weights. In the next section ActGo-Gate platform was presented as a web-based application dedicated for activating and supporting elderly people. Finally, the user interface of the system was evaluated according the proposed criteria.

1 INTRODUCTION

The population in nowadays societies is older than ever, and it is expected to get even older (Rocznik, 2015). Today's seniors are living longer, are healthier, wealthier, have a better education, and are more experienced with technology (Leitãob et al., 2014). This trend is accompanied by the globalization and by the development of the information and communication technologies (ICT). Different studies also acknowledge the increasing number of adults using ICT solutions. The two aforementioned trends are highly connected and dependent on each other. Subsequently there is an increasing call for web-based applications to cater more for elderly users. Designing the ICT systems dedicated for older adults is more complex and challenging than for typical user. The young developers usually have limited experience and understanding in age-related requirements, especially in the context of designing graphical user interfaces (GUI). They are in fact the most important touchpoint where users really interact with the system. That is why there is a strong need to put emphasis on best practices in that area. The good starting point could be to define an universal set of

principles for web-based applications. Thus the aim of the paper is to propose GUI assesment framework and evaluate our aging-centered ActGo-Gate web application based on authors' framework.

2 ELDERLY USERS AND THE ICT IN THE CONTEXT OF DEMOGRAPHICAL CHANGES

Globally, life expectancy for people born between 2010 and 2015 is 70 years (77 in Europe) and it is expected to keep rising. Moreover, population aged 60 or over accounts in 2015 for 12% of the global population (24% in Europe) and this age group is the fastest growing (3.26% per year) (UN, 2015). What is more, many of adult people have the basic skills that allow them to use most interactive devices, and thus, are more likely to already be familiar with computers, mobile devices, and related technology. Eurostat's statistics on ICT show that in 2014 more than one third (38%) of the elderly population (aged 65–74) in the EU used the internet on a regular basis. Over one fifth (22%) of the analyzed population made use of internet banking, this was half the share recorded for the total population

(44%). A similar share (23%) of the elderly purchased products or services via the internet (Eurostat, 2015). The increased participation of senior citizens, demanded by the demographic change, is in line with the observed transition to a decentralized and skill-based service economy. The experience and wisdom of elderly people are a huge asset and underutilized enabler of Internet-facilitated service economy of today (Maciaszek et al., 2016).

Along with an aging population and the opportunities offered by ICT, solutions that reflect on the needs of this particular user group are in demand. Recent technology and software engineering development produce a new generation of applications (Rot, Sobinska 2013) that provide their services in a more flexible and adaptive manner, with easy to use interfaces dedicated for elderly people.

3 ACTGO-GATE – THE PROJECT SCOPE

The problems and opportunities mentioned in the previous section are addressed by the project Active Retiree and Golden Workers Gate (ActGo-Gate). Its vision is to create an ICT based marketplace supporting entrepreneurship, self-fulfillment and social participation for golden workers and active retirees. The project aims to create a transferable model as gate for different occupation modules. The model builds on local social marketplaces that serve as a basis and starting point for developing three occupational modules, starting with an established user base and along existing structures: “Serve the community”, “Flexible occupation”, and “Get involved with organizations”, that will start off in three different pilot regions.

In the long range, the vision is that the pilot cases expand their offerings and converge into the ActGo-Gate as central intermediate for occupation and participation possibilities. The fully developed ActGo-Gate will be the first of its kind to provide a gate for a wide range of occupational possibilities (voluntary, paid, task-based, project-based, etc.). Thereby, market fragmentations as we see them nowadays can be transcended. ActGo-Gate will provide end users with easy access to this integrated gate and enable them to offer their skills, abilities and experiences to other community members.

To integrate the occupational modules with the existing local social marketplaces, a modular approach is targeted for the technical realization. It

will further offer tools for efficient transactional occupational operations (appointments coordination, quality assurance, payment handling, reporting etc.), both for professional as well as informal activities.

4 GUI ASSESSMENT FRAMEWORK FOR AGING-CENTERED WEB APPLICATIONS

The main goal of human-computer interaction (HCI) is to improve the way that users interact with computers and to improve user experience. Interaction design for elderly users is more complex than general user group since they might have physical ability and mental declines. Moreover, most software is made by the younger developers. With their limited experience in age-related decline, they may hardly understand limitation of elderly users (Phiriyapokanon, 2011). GUI design should match with user experience and expectations (Sommerville, 2004). A poor interface can lead to major errors by user mistake. It is the reason that many software application were never used.

In order to design good software, designers should take into account user interface guidelines for elderly users. Ambient Assisted Living is currently one of the important research and development areas, where accessibility, usability and learning play a major role and where future interfaces are an important concern for applied engineering (Kleinberger et al., 2007).

Many researches recommended different user interface guidelines for designing HCI. In different approaches, the researchers argue that the user interface design should be responded to the different user needs, experiences and capabilities. A number

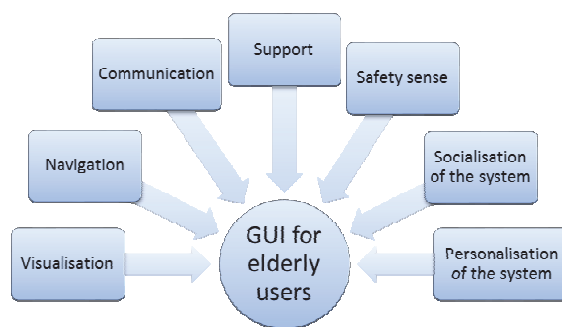


Figure 1: Main groups of GUI categories.

of researches have suggested aging-centered design guidelines (Kurniawan, 2005) (Loureiro and Rodrigues, 2014) (Fisk et. Al, 2009) (Vines, 2015).

We proposed 7 main groups of categories of GUI guidelines (see Fig. 1) with importance weights. Within this set we proposed detailed guidelines, that might improve the performance of the software when used by the elderly users. They are gathered on the basis of results of the literature research

(Boustani, 2010) (Kurniawan and Zaphiris, 2005), our own experiences and focus interviews with experts. The interviews were also used for estimating importance weights for each group. The weights were granted based upon their experience and the observation of elderly people's behaviors using web applications. Experts granted their weights, the average values were calculated and obtained results were normalized. That is why the

Table 1: The proposition of assessment framework for web applications.

No.	Group of GUI guidelines	Importance weights	Proposition of detailed guidelines
1.	Visualization	0,2	<ul style="list-style-type: none"> ▪ Provide generous spacing between items and lines of text ▪ Main body of the text should be in sentence case and not all capital letters ▪ Text should have clear large headings ▪ Avoid fancy font types (suggested font: black font, sans-serif, size: 14+ points) ▪ Make use of proper size interface components ▪ Graphics should be relevant and not for decoration ▪ Use simple and meaningful icons along with labels ▪ No animation should be present
2.	Navigation	0,25	<ul style="list-style-type: none"> ▪ Screen layout and navigation should be simple, clear and consistent ▪ Provide a site map and show the current location clearly ▪ Use the home screen menu and the back button as a safe point of return ▪ Do not use a deep hierarchy, group information into meaningful categories ▪ Avoid double click and minimize the use of the keyboard ▪ Provide only one open window ▪ Links should be clearly named and should be in a bulleted list ▪ Rarely used functions should be removed
3.	Communication	0,2	<ul style="list-style-type: none"> ▪ Design error messages (make it clear that the user isn't the cause of the error) ▪ Make it easy for user to correct input errors ▪ Search engines should cater for spelling errors ▪ Keep communication area in the center of working page ▪ Use word-based interface than graphic-based interface (Bladder, 2008) ▪ Language should be simple, use wordings suiting older adults' semantic field ▪ Avoid irrelevant information on the screen and highlight important ones ▪ Give elderly people time to read ▪ Avoid use of complex interactions and use wizard for complex tasks (one page-one task and confirmations every possible time)
4.	Support	0,1	<ul style="list-style-type: none"> ▪ Provide on screen help ▪ Support user control and freedom ▪ Error messages should be simple and easy to follow ▪ Provide feedback continuously, distinct feedback from each action ▪ Be prepared for older adults that refuse to learn
5.	Safety sense	0,15	<ul style="list-style-type: none"> ▪ Provide and attach reviews, users' opinions, certificates and usage statistics, which would increase the sense of safety for the elderly users
6.	Socialization of the system	0,05	<ul style="list-style-type: none"> ▪ Allow discussion and comments on content (enquiries about the details, reviews, comparisons, opportunity to be heard, to receive notifications) ▪ Provide activity log, activity feed, timeline ▪ Allow to establish a relationship between users: profiles and relationships between them, the opportunity to follow the profile ▪ Provide viral marketing content: direct recommendations between users
7.	Personalization of the system	0,05	<ul style="list-style-type: none"> ▪ Ensure the user can easily make interface elements larger ▪ Provide ample time to read information ▪ Accessibility issues should be taken into account ▪ Enable older adults to adjust the volume at their will ▪ Increase duration of sound signals if needed ▪ Allow users to store shortcuts to their favorite functions

most important ones are navigation, visualization, and communication, while the personalization and socialization seem to be less important for users.

The proposed model can be used as an universal assessment framework for aging-centered web applications, which could be used for evaluation of the extent of fulfilling the UX-related requirements. On the basis of it we perform an evaluation of the ActGo-Gate platform.

5 IMPROVING ELDERLY USERS' EXPERIENCE IN USING WEB APPLICATIONS – THE ACTGO-GATE CASE STUDY

The ActGo-Gate platform is a gate web application, which main functional feature is to gather occupational opportunities, coming from different service e-marketplaces, and offer them to older adults. In a result, it stimulates its end users to active participation in occupational-oriented communities, where people could help each other in the fields, they are experienced in. Users can search for one-time formal and informal services, search for long-term, recurrent jobs or post a one-time demand of something that has to be done for them.

Technically, the gate application is an offer aggregator, that integrates some data flows (offer feeds, notifications). The information on offers is standardized and grouped into categories which can be browsed in different views of catalog: the list, the grid and the map. Each view is focused on alternate information: the list – on name and short text description of the offer, the grid – on its graphical illustration, and the map – on its localization. The catalog is built with the intent to browse offers quickly and efficiently by using basic or advanced sorting and filtering options. Also a location-oriented full-text search engine is provided to users for shortening the way of getting the right offer if they exactly know what they are looking for. The geo-location is an important part of the application as it is able to adapt to current user location and provide him/her with offers nearby him/her. It also enables single sign on to all connected web services (therefore with using an ActGo-Gate account users can log into each connected service). On the other hand in ActGo-Gate user profile section users can edit their user data (which will be synchronized with all connected services), browse and manage all offers belonging to them and view all notifications coming from connected services. The core logic of

the specific processes (like recruitment or appointment coordination) remains the responsibility of particular services. The web application is designed with the principles of responsive web design paradigm using technologies like HTML5, AngularJS, Bootstrap and Sass. That is why it can easily adapt its content to different screen sizes of end devices.

Taking into account the proposed assessment framework, we would like to check to what extent the ActGo-Gate application is currently adapted to the perceptual characteristics of its target group.

The visualization of the platform is intended to be suitable for perception of elderly people. First of all we use large sans-serif fonts – Source Sans Pro with minimal size of 18 pts. Spacing between items and text lines is intended to be kept as large as possible. All components are large and clearly separated from other parts (some are hidden and can be displayed intentionally like advanced search filters). The headings are highlighted so they can be easily identified. Selected elements on the web pages are equipped with adequate icons and labels on the desktop view (on mobile views only icons are displayed to ensure readability). The active elements react on hover actions by highlighting the active element. The color palette consists of white, blue and black. Such a palette makes the interface clear and light – most of texts are black. Graphics are used for being the background of primary call to action and to strengthen its message by presenting elderly people that are actively spending their free time on the retirement. Other graphics play the role of illustrations supporting the text messages (e.g. photos of people in testimonials) or give the real information value. The animations are limited to the extent possible. We can then assess that part of the framework as passed with 100% accuracy.

Very important issue was to provide an intuitive and simple navigation schema and consistent vocabulary for supporting users at every stage of the app usage. The user interface is designed to be consistent in each part – there is a common header and common footer section, that help to navigate inside the platform. The similar convention of building particular modules is used – highlighted titles, rectangular buttons, the same hover actions on active elements of the website (mostly the background of the element is getting darker). Once used element looks the same in each part of the platform: search form is the same on landing page as well as on the catalog page; although it is a separate view, also uses the structure of the catalog list.

For easier navigation a breadcrumbs module was prepared, which aim is to show the current location of the user within the structure of the website. It enables to locate users themselves but also to skip to any top level location from that point, including the home page. The back button in the browser could also be used in most cases as asynchronous communication within the platform is limited to the possible extent. There are also shortcuts to the catalog, adding new offer feature and to the user profile section. We don't provide a site map.

Links are named clearly, mostly with using full phrases. Double click is not used at all, while keyboard usage is minimized to fill out the contact form and search forms. Main content entity – the offer – is categorized and the lists/grids of offers are dynamically paginated. Both concepts are aimed at minimizing the number of offers to be reviewed by the user. The platform uses pull down menu for user profile sub-menu in the header as well as in the filters section of the catalog, what is inconsistent with the defined GUI principles. The requirements made us to use modal windows when presenting the content from connected web applications. Such a solution is a mode that temporarily disables the main window, but still keeps it visible with the modal window as an active child window in front of it. To return to the parent application, users have to interact with the modal window first. Users do some actions there, like reading offer details, requesting it etc. and finally close the modal window. Following this line the registration and login path was based on the same pattern with using modal windows. Summarizing, the score of navigation part of the framework could be estimated as completed in 85%.

The communication between the user and the system is another priority. The application is multilanguage-ready. Each page (except the landing page) provides one main function so it doesn't distract users. The communicates are simple and easy to understand by the users. Only important information are presented to the user, most important ones are specially highlighted like our main Call to Action. The general communication is usually conducted in central part of the application. The designed user paths are shortened, not complex and equipped with proper after-action messages – confirmations or error reports. The errors of the users are communicated clearly, supported by special styling of the input with wrong content but they are not handled by any autosuggestion mechanisms and not corrected automatically. Search engine isn't able to handle input errors and display correct results. System errors are reported

differently, so users know that they didn't cause the problematic situation. Because of lack of mechanisms of errors autocorrection and inflexible search engine the overall score can be only 70%.

Support of users at primary stage is also very crucial issue. The platform provides a categorized help system based on Question-Answer (QA) model. User can also search for relevant content or use the embedded video introduction, where most important functions are explained. User is also supported by contextual help. Each content element is tagged and those tags are the basis for selecting proper help notes on the top of the list. For feedback the universal contact form could be used – there are no plans to organize a special tool for feedbacks. The support group can be estimated as compliant with principles in 90% because of the lack of dedicated tool of gathering feedback.

The platform considers a safety sense as an concern and therefore does everything to convince the user about the quality of offered services, reliability of the providers or recruiters on the platform as well as the platform itself. We present success stories (testimonials) of former users of the platform and the strong academic and socio-political foundations of AAL Europe, National Funding Agencies and leading Swiss and Polish universities. The platform presents logotypes of all patrons and supporters. The visualization and communication also are aimed at maximizing the trust building. The possibility of reviewing offers on the basis of previous transactions has not been implemented yet. Resultantly, this part can be assessed as 80% compliant with the principles.

The platform doesn't provide any social features that allow building communities and widely named socialization. Some functions can be provided by client applications but there is a need of making an additional effort to go directly to the client, find it there and utilize data. The score for this part is 0%.

Personalization of the system is the last group of principles to discuss. ActGo-Gate platform is offering adjustment tool that allows for resizing text content from 18 to 22 pts and change the original layout on the simplified, high-contrast one. The application will adapt properly to any screen size. The application doesn't handle voice communication so people with serious sight disabilities can't use it currently but improvements in that area are planned. The application gives the possibility of marking offers and categories as favorites so the users can have a quick access to them. The overall score for that part is estimated as completing the requirements of the framework to the extent of 90%.

The overall calculation gives the following result: $(0,2 \times 100\%) + (0,25 \times 85\%) + (0,2 \times 70\%) + (0,1 \times 90\%) + (0,15 \times 80\%) + (0,05 \times 0\%) + (0,05 \times 90\%) = 0,8075$, what means that the gate application is compliant with up-to-date GUI principles for elderly people in 80%, which means that the application is ready for being used by elderly people – should support them in their operations on the website, guide them to the target efficiently and communicate easily, but only by text. Users should feel safe on the website – the personalization features should make the impression of “their” place in the net. Two dimensions that definitely should be improved, are socialization of the website and making the voice communication available for people with sight disabilities.

6 CONCLUSIONS

The study has demonstrated that the elderly people experience a number of issues concerning the access and use of the web-based applications. Their growing health disabilities, as well as fact of rapidly aging society especially in the developed countries, make them the special group of interest for GUI designers of web applications. Based on the cognitive findings of the paper the utilitarian tool for improving UX of modern GUIs – the assessment framework with set of detailed guidelines – was developed. With the use of that tool the characteristics and evaluation of the platform was made. All the details concerning the interaction between the users and the system were explained in the context of each framework category. In a result a few missing important functions were identified, which should be taken into account in future releases of the application. Despite these minor shortcomings the application still can be considered as being adapted to the needs of elderly people and providing positive user experiences. As a further research it is planned to run a field trial with elderly users, the system will be evaluated to identify potential areas of improvement.

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