Accessible and usable User Interface for a personalised health services Web platform

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Abstract

Current health care systems in developed countries are called to face up many challenges, principally represented by the aging of population and the resulting rising of chronic diseases. Aspects like prevention, continuity of care, therapy compliance, personalisation of information and patient motivation are the main objectives of such systems, along with the necessity to reach the higher portion of the population as possible. This work shows a usable and accessible Graphical User Interface (GUI) that, applied to a personalised health care information platform, aims at making it accessible and user-friendly to every kind of patient, including people with special needs and with little skills in Information and Communication Technologies (ICT).

Keywords:

GUI, usability, accessibility, W3C, WAI, XHTML, CSS, motivation, prevention strategies.

1. Introduction

Aging of the population has become a world trend, and current health care systems have to face up with its consequences. In the next 50 year, world population aged 60 years or over will triplicate, passing from 600 millions in 2000 to nearly 2 billions in 2050 [1]. This will affect directly the incidence of chronic diseases, like obesity, diabetes, cancer and cardiovascular diseases.

Such diseases represent a big problem for public health systems, in terms of structural and economical resources spent in their care and their related pathologies: the UN agencies WHO and FAO indicate that chronic diseases "contributed approximately 59% of the 56.5 million total reported deaths in the world and 46% of the global burden of disease" [2]. The cost associated with the care is very high, and becomes higher taking into account all complications and related pathologies; in these cases, the cost could rise four or five more times.

Existing health care systems main function is to help patients in the care of these diseases; nowadays, the great utility of ICT is a proved issue however, there is the need of a new prevention and patient focused paradigm with the co-presence of various factors like:

- **Prevention:** is the principal solution to chronic diseases and acts on risk factors that could be easily reduced (hypertension, high cholesterol level, obesity, poor physical activity and bad eating habits).
- **Continuity of care:** implies supporting citizens during all their lives, not only in presence of a disease, but also providing qualified information and helping individuals in adopting healthy lifestyles and facilitating communication with doctors.
- **Therapy compliance:** as reported by a recent survey, "more than 50% of patients do not comply with medical prescriptions" [3]. Patients' active collaboration is important for avoiding relapses, re-hospitalizations and resulting medical costs.
- **Tailoring of information:** takes into account citizens personal information, preferences, habits, likes and dislikes and provides personalised information when needed, a real added value in health care systems, as many of them only provide generalised advices.

Good early preventive actions can act on educating about the main causing risks, and prevent from relapses. For this purpose, at the moment of providing information, it is important to reach the wider audience possible, not only addressing the patient, but also including healthy citizens, promoting healthy lifestyles. In this sense, motivation, intended as the manner that information is provided in terms of content, tone and format, plays a key role in the way systems guide citizens towards healthy attitudes.

A Graphical User Interface (GUI) is the aggregate of means (graphics + text) by which people and a computer (system) interact in a bidirectional mode. If the system aims at reaching a wide audience, is the GUI that has to be constructed in a way that allows the best communication with users. In particular, concepts of accessibility in providing information, and usability in designing the way users can move inside the system and interact with it, have to be taken into account.

Besides, multi-channelling is an important aspect, especially if the system needs to reach individuals ubiquitously, being always present in all the aspects of their life. For this reason, it is important to consider mobile access to the system (with devices like mobile phones, PDA, etc.), using appropriate User Interfaces.

In this work, a usable and accessible web GUI for a personalised information platform is presented. Its main objective is to contribute to comply with the issues mentioned above. Innovative and W3C compliant technologies are used in the implementation, like XHTML (eXtensible HyperText Markup Language) in combination with CSS (Cascading Style Sheets) [4], following WAI guidance for accessibility [5]. Moreover, the particular choice of the structure and elements disposition in the pages, gives to the GUI important usability features, even in a PC or a mobile phone access.

2. Materials and methods

When developing a web GUI, a first step is to identify the system target users. UIs should be designed in order to fit the users' needs or to be adaptable if required, as some people need the system to present special features. More specifically, to make information accessible for users with visual, audio, cognitive or intellectual deficiencies, the Web Accessibility Initiative (WAI) has provided recommendations about accessible web pages programming. Some of them are presented below:

- XHTML has to be used with CSS to separate the information from the style elements correctly
- XHTML code will contain only "pure" information and main structures, allowing special browser to understand better and to present elements in the page in the correct order.
- In addition, every media element (images, videos, sounds, etc.) needs to be completed with an alternative description, letting web browser to render the contained information in other ways. Finally, complex XHTML structures like tables have to be used only to list information (never for positioning) and completed by detailed headers-to-cell references and summaries. Other recommendations indicate that the colours of texts have to contrast with the background, that pages have to work properly also with script languages not activated, and that relevant information has to be placed at the beginning of paragraphs, list, headers, etc. (front loading style).

While accessibility is an objective measure, usability is only a subjective perception, but is of crucial importance and needs to be taken into account when building a GUI. Usability is defined as the "extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [6]. As this definition suggests, usability is an approximate but powerful principle to measure how the user feels in using an application or a system through its GUI.

The main paradigm is the centrality of users, and developers have to understand their point of view to better capture their needs and abilities. The system through its GUI must result simple, immediate and easy to use without any kind of previous training. There are several principles to follow to make a GUI usable:

- Work on a "tree-structured" application, with hierarchical levels. The first levels devoted to more general functions or information and more in depth less for specific functions or information. This helps the navigability of the system and the user can easily go back to the tree root (main page).
- Build a simple navigation menu, with items organised in few levels and grouped by functions.
- Always provide contextual information, to help users understand their position in every moment.
- Provide redundant links for page navigation (i.e. *back, top, home, etc.*).
- Let users go back in their decisions.
- Always ask confirmation for destructive choices.

In addition, in the case of mobile devices:

- Show little amount of information. Limit only to the most relevant.
- Limit tables to a maximum of three columns and eventually divide rows (group them in different pages).
- Reduce the parts where the user is forced to input. Replace them with selection boxes, checkboxes or scroll-down boxes.

Moreover, a usable GUI needs to be aesthetic and stimulating. Information has to be placed in specific parts of pages to better reach the user, with solutions that help the acceptance and the transparency of the system, especially in the case of a health care system which aim is to gradually motivate citizens to changing their habits or, at worst, impose treatments.

In order to test the GUI a first prototype was presented, and after collecting feedback from the users, a new version, incorporating the relevant suggested changes was released.

3. Results

Although theoretically the design of a UI in its higher level (XHTML code and CSS style) is not influenced by the particular system implementation, in practice, the implementation is quite dependent on its functionalities and architecture. Thus, this work has been divided into two phases:

- UI designing and modelling
- Implementation and adaptation

Pages structure is a collection of XHTML *div* elements, properly nested. These elements represent "neutral" and "style-free" containers of pure information (or other XHTML elements). The power of divs reside in coupling them with a CSS style (using a "class" reference) adding them all the graphic and positioning information, like colour of fonts, background images, relative and absolute dimension, position in the page in relation to other elements and visibility. In theory, starting from the same XHTML code properly coded in *div* elements, very different visualisations can be obtained, using different CSS style sheets. Moreover, *div* elements are in absolute transparent to a special browser, an important aspect when retrieving pure information for an audio output.

In the case of PC browsing, the pages structure have been divided in the following sections (see Figure 1):

- A **header**, which contains the project title and logo and the assistant, a very important element which is discussed in depth later in this paper. A sub-header, positioned under the header and containing welcome messages and the navigation information. Levels and sub-levels are links, by which the user can easily go back in the level tree. These improve the system usability by providing the user with the exact position from the application root.

- A **menu** positioned on the left, which summarizes the system services. The usability of the menu implemented is guaranteed by limiting the sub menus to a maximum of two levels, and by grouping services by functionality, so users can easily find what they are looking for without an excessive effort.

- The **main section** of the page contains the output of system services and the information to be provided to the user. Placed at the most relevant area of the page, this section organizes the information in a set of div elements properly nested, creating a nice-to-see and very effective series of boxes and sub-boxes, all rendered thanks to CSS. Different types of boxes have been implemented, each one responding to a specific necessity of visualisation: boxes that occupy all the line, left or right aligned boxes, nested boxes, etc. CSS style is provided to render various XHTML elements contained into boxes divs: titles, list, tables, forms, and others. Especial attention was paid to build tables, in order to comply with the WAI requirements of accessibility (level AA).

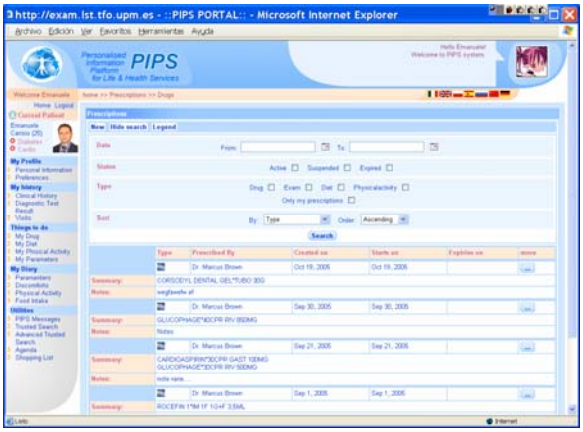

Figure 1. Portal web pages structure.

A very useful help to the page structure implementation is the CSS style sheet that permits the correct visualisation of the various elements above mentioned and others. Moreover, it supplies to all the graphics necessities in visualisation, according to the principle that a good level of usability resides in a user-friendly and good-looking GUI too.

Toolbars are a really useful feature. Implemented as simple XHMTL *list* elements with CSS style, they allow representing a set of links organized as buttons horizontally aligned. These elements are efficiently used to implement recursive commands (like the *back* and *top* links) and other specific actions.

A peculiar space at the top of pages, inside the header, has been reserved for an innovative and high user oriented feature of the platform: the *personal assistant*. Represented as an *avatar* "talking" inside a comic balloon, the assistant allows a quick and direct

communication to the user, giving a high level of importance to specific messages from the system, i.e. medical reminders. Moreover, it helps the contextualisation of services giving a brief description of the service invoked, or just reminding the main functionalities of current section of the portal, enhancing the usability of the system.

A similar design solution has been adopted in designing web pages directed to mobile phone browsers (see Figure 2). Naturally, limited dimensions of the screen forced a simpler page structure, with only the header and the main section. The menu is present only in the main page, but the linear and tree-like structure of the application remains. The position data is always provided by the header's navigation tree. Other element that has been sacrificed is the personal assistant, but, in any case, services offered in the portal mobile version are specific ones, simplified and mobility-oriented. Usability is preserved following principles enounced in the last paragraph.

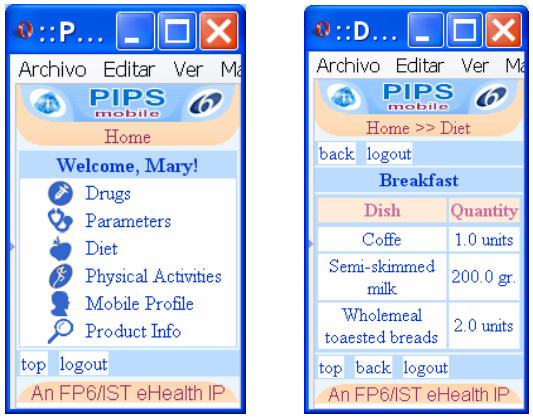

Figure 2. Pages in the mobile browser.

Once the GUI was designed, it had to be adapted to a particular system implementation. The efficient and adaptable structure of the UI made possible not to depend on different system architectures. Distinct frameworks only have to be forced to produce the required XHTML in the desired format including the CSS style sheet. The current version of the platform is implemented in Nukes technologies on a Jboss server and a future transition to Jboss Portal compliant with Portlet specification is envisaged, but this will not introduce relevant changes to the GUI design.

4. Discussion and conclusions

The work presented in this paper fulfils all the requirements of accessibility and usability. Accessibility level AA (over AAA) is reached, and was verified by the T.A.W. (web accessibility test) tool [7]. This is a good level, that allows a special browser to understand the page and present it to the user.

The UI is also very immediate and simple to use and all special features like the navigation tree, the menu and, specially, the personal assistant cooperate to the overall usability. These contribute in a important way to improve the motivation aspects of the application, allowing the system to communicate in a more effective and direct way to the user, with the final aim to guide him to healthy life styles.

In addition, the UI built is strongly adaptable to every system implementation and technology. The future migration of the portal to Portlet technology will correspond to insignificant changes in its structure.

Finally, the UI allows the system to be accessed also by a mobile phone and without many efforts can be extended to any mobile device (PDA, palm, etc.).

Summarizing, this work is a good contribution in the research of more usable and motivating ways of communication between health care platforms and users.

5. Acknowledgements

We would like to thank the PIPS Project (project partially funded by EC, IST 507019), in which this User Interface is being implemented.

10. References

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