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User Interface Design in Medical Distributed Web Applications

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Abstract. User interfaces are important to facilitate easy learning and operating with an IT application especially in the medical world. An easy to use interface has to be simple and to customize the user needs and mode of operation. The technology in the background is an important tool to accomplish this. The present work aims to creating a web interface using specific technology (HTML table design combined with CSS3) to provide an optimized responsive interface for a complex web application. In the first phase, the current icMED web medical application layout is analyzed, and its structure is designed using specific tools, on source files. In the second phase, a new graphic adaptable interface to different mobile terminals is proposed, (using HTML table design (TD) and CSS3 method) that uses no source files, just lines of code for layout design, improving the interaction in terms of speed and simplicity. For a complex medical software application a new prototype layout was designed and developed using HTML tables. The method uses a CSS code with only CSS classes applied to one or multiple HTML table elements, instead of CSS styles that can be applied to just one DIV tag at once. The technique has the advantage of a simplified CSS code, and a better adaptability to different media resolutions compared to DIV-CSS style method. The presented work is a proof that adaptive web interfaces can be developed just using and combining different types of design methods and technologies, using HTML table design, resulting in a simpler to learn and use interface, suitable for healthcare services.

Keywords. User interface design, web interface design, application analysis, HTML

1. Introduction

Modern Web applications have DIV technology based layout design, combined with CSS (Cascade style sheet) programming language, which gives properties to HTML elements in the document. Many developers prefer this technology because it uses a simplified HTML code. On the other hand, CSS files containing classes, styles and properties can become very complex in coding lines, especially when the layout is developed to be adaptable to different resolutions, like concept of “cross browser”, "responsive design", "fluid design" [1]. HTML technology TD (table data) and TR (table rows) is considered by many obsolete, due to the many HTML lines of code needed for building a web layout interface. Besides is considered outdated, it is still used to build and maintain a fixed resolution graphical interface that is NOT adjustable on mobile

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tablet or smart phone [2]. One of the advantages of TD versus HTML DIV, is that it can be very well optimized for mobile applications without using multiple properties CSS files or CSS classes for each HTML element. DIV tag technology requires creating a separate class for each style or CSS property of a column or line within the HTML document. This is not necessary in TD HTML based design.

The existence of table attributes makes for a rather flat learning curve because the developer doesn't have to use a separate style sheet. With DIVs, the developer must use the style attribute or an external style sheet, because the div tag doesn't have any attributes attached to it, compared to TD that has his own attribute properties [3]. Also, tables don't break when the content is too wide. Columns are not squeezed under other columns as they are in a div-based structure. This adds to the feeling that using tables is safe [4].

Using a DIV for structure can make a page more fragile when content is pushing the div to its limit. It can also force columns to fall under each other. But this is usually only true for older browsers (particularly IE6); newer browsers make content flow to the next column.

Every extra DIV the developer adds, makes layout code harder to read by browser and difficult to edit by another designer. More lines of code lead to longer download times and so on. On the other side, HTML table based design, despite that is more complex in terms of coding, is more developer friendly, because each table has his own properties like "width and height" and the developer is not forced to edit the CSS files to change the attributes and styles of a table. Besides that, table based design code can easily edited using web editors like Adobe Dreamweaver, that is a very professional web editor used by most of the web developers in present days [5].

Using HTML table design can provide a more efficient way of flexibility with different media devices, as long as the design is separated from the content and inserted in the CSS style sheet [6,7]. Also a table design layout is easy to maintain because offers the possibility to move or insert new rows and columns without touching the CSS code. It also provides a reliable way to manipulate the objects and image placeholders in the document, using only the TD properties. This things can't be applied in DIV based designs, since DIV is dependable on CSS styles [4].

DIV is more less code required to achieve the same result. DIVs also give you more control of how things should look. But it does take more time to decorate it and require more testing with different browser, such as Firefox, IE and Chrome. Different tests need to be done with different version of browsers, as well as Operating systems. A page could look different on a Mac with Firefox or on Windows with Firefox using DIV based design. However because DIV based layouts are dependable on external CSS language, getting the CSS to act the way that you want, can be a real challenge [8].

The TABLE based design, is a still a good way to design and build web interface layouts, because is more user friendly, each table has his own property and is not dependable on CSS styles [9].

icMED is a web-based medical information patient management system, which works using interconnection between offices, clinics, medical centers, hospitals, laboratories, pharmacies and emergency centers. icMED provides performance indicators, which are budget based information input by physicians, then centralized on a web server. Other advantages of application icMED are the automatic completion of medical records, electronic patient records, reports to insurance offices etc. icMED is an innovative concept and an effective tool for managing patient treatments by healthcare professionals, clinics or laboratories. This application, by its nature and complexity,

offers users full support for deployment in optimal conditions and fair activities, using a common database of unique electronic files. icMED is a product that provides professional services for healthcare providers, making it an efficient modern tool, rather than the classic methods of pen writing specific documents, tracking their epidemiological indicators, activity or budget.

icMED is a widely system used in Romania by medical centers, hospitals or private practice that supports exercise healthcare system in public and in private centers. The online application offers technical support via a call center at no additional cost. It is currently the only Romanian project which has been designated as "good practice" in the European program PEOPLE. PEOPLE program rewards the best initiatives and projects in the field of improving workflow, increased service quality and improving the economic situation for all levels of stakeholders.

The aim of the current study is to prove that using HTML table design to build adaptive media web interfaces is a reliable alternative to the more complicated DIV tag layout structures. From the designer perspective, using HTML table design to develop web layouts is easier, in relation to the structure of the code and the ease to edit, in comparison to DIV structures.

2. Methods

2.1. Analysis of the current interface

A screenshot of current index layout page of the icMED medical application is shown in Figure 1. Currently, the icMED web interface application is developed using DIV tags and javascript codes and scripts. The current interface has been designed 8 years ago and has been constantly improved. Given that 8 years ago, adaptability to different media resolution was at the beginning, the online application was designed to be viewed especially from desktop computers and laptops. Although being an online application, which can be accessed also from media devices, it was developed as a standard HTML fixed web page, with fixed resolution. The graphical interface is designed to be viewed from a standard resolution of 1024x768 pixels. Being a very complex application, with many subpages, it is addressed especially for users from the medical system, as doctors, specialists etc.

Many dynamic elements of the current application are incompatible with the modern media technologies, as the FLASH elements incompatible with mobile operating systems. If the application is accessed from a mobile device, flash elements are not displayed correctly. Moreover, mobile browsers do not even load the page containing embeded objects that cannot be interpreted by the browser.

The application is designed on a framework based on the source graphic files, which are stored on a web server. These items are loaded into the interface, expanding access time. At the same time, using graphic images for the interface design, the application code becomes very rich, and increases the risk of encountering display errors in different browsers. Features like colors, frames, text or icons are present in the interface as separate graphics. A real disadvantage for users is that these items are not properly interpreted by the entire browser, especially on mobile browsers, making the application harder to navigate, especially on mobile devices. This is a real disadvantage for the mobile based users.

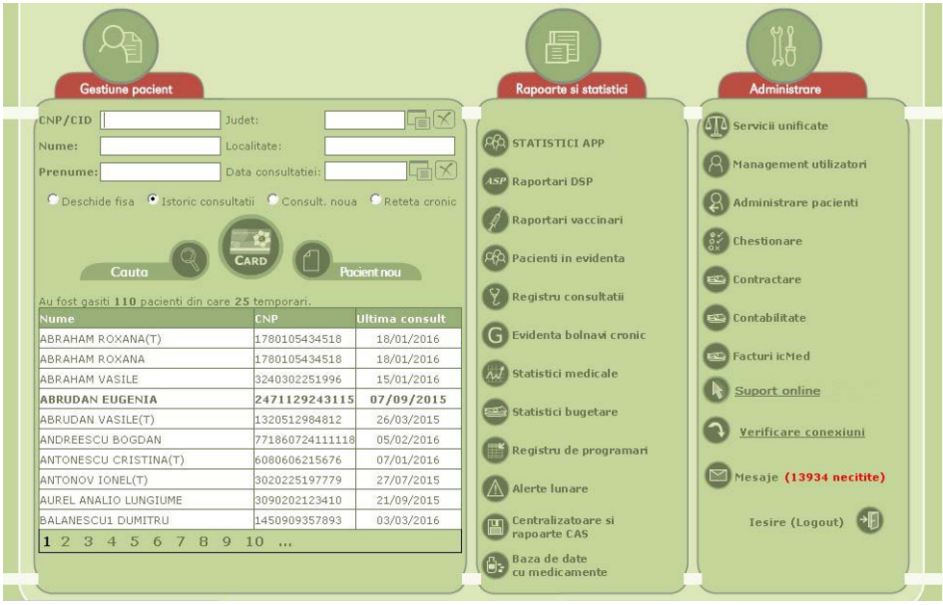

Figure 1. Current Index layout page of the icMED medical application

8.000 users are currently using the icMED application on a daily basis, and many consider the application to be outdated, in terms of layout design and adaptability to media screens (see Figure 1). The most frequent usability errors encountered by the users are: broken links, missing images sources and HTML overlay text in some subpages, long page loading time and interpretation errors on mobile browsers. Therefore in collaboration with the icMED research department, a new prototype layout was proposed using HTML TD technique in order to develop a more efficient layout that fits on every media screen (fluid design, responsive design, cross-browser design) and is developed using only HTML code for design, instead of using graphic image sources.

2.2. New Layout proposal

After a short technical analysis of the current interface, in which improving engineering opportunities were highlighted in terms of design and development, a new layout proposal has been made for a modern interface with "fluid design" technology, using HTML table coding in combination with CSS3, to be more dynamic and efficient. Using HTML table and CSS3 technology resulted in a graphical interface developed exclusively from code, without additional graphics or images in the source, improving the interface dynamics in terms of accessing time and display across different types of browsers, especially on mobile devices.

2.3. Coding and scripting

The prototyped interface is developed using HTML and javascript. HTML language offers a large scale of possibilities in relation to code and optimization, making it very easy for developers. Being a prototype interface based on HTML table technology, has a very rich source of code lines, reaching up to 300 lines of code / page. The DIV

technology design results in a reduced number of code lines, but needs the rich CSS classes' files and styles for each type of DIV, complicating the development process. The interface contains only one CSS file, called *frames.css*, with few classes and styles. Every style or class can apply to one or more tables, reducing the time of the interface development process. Another improvement in the prototype layout is the tables property. All the tables had the *width* and *height* properties set in percent (%). This ensures that the entire layout is adaptable on different resolutions, making it more *cross browser responsive,* compared with DIV technology, where all the cells properties are written in CSS styles. In this case it was not necessary to write CSS styles especially for rows or columns properties. Also the colors of the cells and even the graphical shadows are set directly from code, without using any external graphical files. For graphical shadows, to be well interpreted by all the browsers, a predefined CSS code was used*: webkit-box-shadow* for Google Chrome, *-moz-box-shadow:* for Mozilla Firefox and *box-shadow*: for Internet Explorer, or Microsoft Edge browser.

In order to be displayed properly on most mobile devices, the prototype contains a *@viewport{}* script in the HTML code, with maximum and minimum resolution (**Figure 2**.). The minimal resolution is 640 pixels and the maximum 800 pixels. Most modern mobile devices have a minimum resolution of 640 pixels. In this way the interface is displayed correctly on the devices and the side scrolling will not appear in navigation. To increase readability, the *@viewport{}* script uses lines of code to optimize the text displayed on screen devices, increased by an amount of 1.5 – 2.5 of its standard size.

Figure 2. Simulated prototyped icMED layout adaptation on smart phone

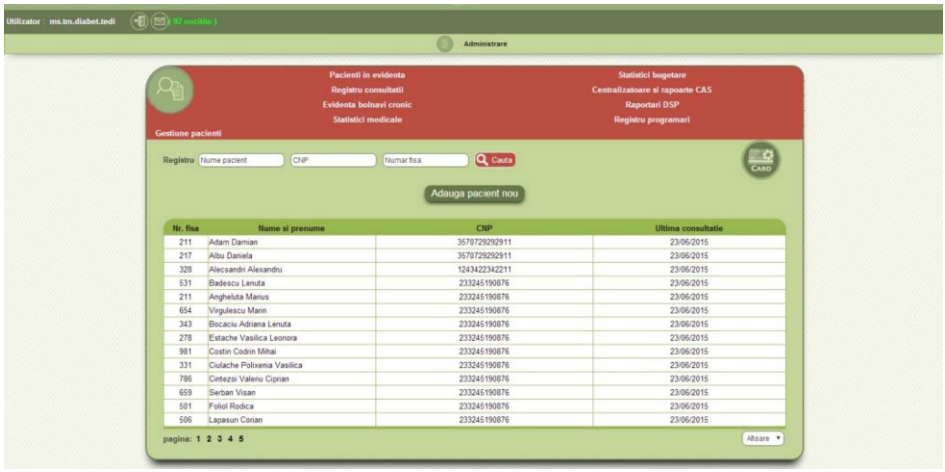

Figure 3. The new responsive layout proposal for the icMED web application on a resolution of 1600x900 pixels

3. Results

A prototype web interface was developed, for an online medical application (icMED) dedicated to medical professionals, patients and laboratories, using HTML table technology and CSS3 language, as an alternative to HTML DIV technologies. Several advantages and methods where highlighted when using HTML table design for developing dynamic and adaptive user interfaces for various media devices.

3.1. The new prototype interface

In the design process, the aim was to achieve a graphical interface based on intuitive user experience (UX), using different techniques and methods of the field. The absence of image sources design resulted in an improved source code quality used while simplifying the number of scripts required to achieve the graphical interface. The only common elements kept in the current interface, shown in **Figure 3**, are the same color range and icons, as identifiers of application's sections.

The links to subpages have been preserved entirely, but repositioned on the main page, and divided into primary and secondary links. The primary links have been relocated in the center of the page with a red background for a better identification. The secondary links were "hidden" in a section called "Management", because they are actually the links to the personalization module of the application. This improvement has provided a larger work area for the main interface, compared to the current interface where all the links are displayed in two rows. Another improvement, in terms of UX, is the use of text fields with text identification inside (**Figure 4)**. This was made possible by coding value *"value=" identification text"* in the html code assigned field. This method is more efficient than the classic one, in which the identification text is separated from the text field itself. Using this technique, more design space was saved for other necessary interface elements. This improvement is especially effective when the application is used on mobile devices, where low resolution does not allow expansion of the interface.

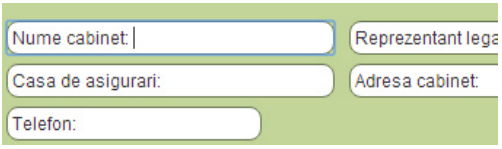

Figure 4. Identification text inside dynamic text field

Currently having a consistent group of medical staff using the application (aprox. 8,000) the new interface is in testing and collecting of feedback comments. During the testing process the icMED's users will provide information for the following parameters: ease of navigation, display or interpretation errors, intuitive navigation improvements and adaptability errors to media screens.

4. Conclusion

The paper presents new methods and techniques for design and implementation of user interfaces using HTML table technology in complex medical applications. This method represents a viable alternative to DIV technology, which is widely used today by most developers for building web interfaces. The methods and technique presented is a proof that dynamic web interfaces and adaptive can be developed combining different types of design methods and technologies, using HTML table design. The work presented in the paper is the first step, the technological improvement that has to be confirmed also from the users' perspective in a future step.

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