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The Model of Quality Assessment of Automatically Adjusted Responsive Web Pages and Applications

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Модель оценки качества автоматически настраивающихся отзывчивых веб-страниц и веб-приложений

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Модель оцінки якості адаптивних веб-сторінок та веб-додатків

The paper presents a model, which can be applied to Graphical User Interface testing. The model is dedicated especially to web pages and web applications created using Responsive web design. The procedure is based on expert method and cognitive walkthrough. The paper outlines contain the description of responsive web design, used methodology, GUI evaluation process and the application description.
Key words: responsive web design, RWD, RWD, GUI usability, user experience.

В статье представлена модель, которая может быть применена к тестированию графического интерфейса пользователя. Модель предназначена особенно для веб-страниц и веб-приложений, созданных с использованием технологий адаптивного (отзывчивого) веб-дизайна. Процедура основана на методе экспертного и когнитивного пошагового обзора. В статье изложено описание отзывчивого веб-дизайна, использованной методологии, процесса оценки интерфейса и приложения.
Ключевые слова: адаптивный веб-дизайн, RWD, RWD, удобство графического интерфейса, удобство работы.

У статті наведено модель, яка може бути застосована для тестування графічного інтерфейсу користувача. Особливо модель призначена для веб-сторінок та веб-додатків, створених за допомогою використання технологій адаптивного веб-дизайну. Процедура заснована на методі експертного і когнітивного покрокового огляду. У статті наведено опис адаптивного веб-дизайну, методології, що використовується, процесу оцінки графічного інтерфейсу користувача інтерфейсу та додатка.
Ключові слова: адаптивний веб-дизайн, RWD, RWD, зручність графічного інтерфейсу, зручність роботи.

Introduction

Computer market gain certain stability. According research [1] most of people (in USA) own laptop or desktop computer. However, more and more people buy also smartphones and tablets. This trend of rapid adoption of smartphones and tablets will be continued in the near future. That is why it is very important to adapt web applications and web paged to requirements of growing number of mobile users. Nowadays it is more important than never to design cross-channel websites [2], websites prepared to be accessed from a myriad of different devices.

Responsive web design (RWD) can be treated as a solution to the problem of necessity of automatically pages adjustment to all type of devices, like desktop computers, notebooks, tables or smartphones. The term "Responsive web design" was proposed by Ethan Marcotte in 2010 [3]. In 2012 "responsive design" was declared to be the second development trend of the year [4].

The goal of RWD is to deliver a quality experience to users no matter how large or small the display they use is. But RWD is not only about changing the way elements are displayed in a web page: RWD is also about how to provide easy reading and navigation with a minimum of resizing, panning, and scrolling across a wide range of different devices. Responsive web design mixes three different techniques, fluid grids, flexible images, and media queries, all of them based on the use of CSS (Cascading Stylesheets).

GUI of the responsive design web page needs to be checked and tested by users working on different type of devices. The site designed in this way should be adjusted to different kind of screen resolutions (computer monitors, smart phones, tablets, etc). It should be readable with a minimum of resizing, panning, and scrolling.

To check users' viewing experience GUI quality evaluating methods might be used. During such case study users experience also needs to be regarded.

Novice users interacting with a system for the first time prefer simple actions and ease of learning [5], but their behaviour and work quality changes as their experience with the system increases. This is an important point of view when evaluating GUI quality over time, but to setup such a study requires observation over time and lots of resources [6], which are often hard or even impossible to obtain.

An expert analysis in combination with cognitive walkthrough seems to be the most reliable method in case of assessment of responsive design web page GUI quality. As it is shown in the studies [7] in most cases group of several experts using the adequate methodology is able to detect and correct over 85% of errors in software – this applies also to errors in GUI quality. It should be noted that testing can never completely identify all the defects within software [8].

1 Responsive application

The example web page was created using Foundation framework dedicated to responsive web design. The web page should be readable with a minimum of resizing, panning, and scrolling. It was created to present user interface navigation mechanism and to get know users viewing experience.

The web page is simple, it does not have extensive functionality. It contains several main sections:
– Articles – extended thematic articles including photos.
– Gallery – several galleries each containing a collection of photos
– Form – typical web form composed of several questions.

The home page contains news shortcuts and links to the remaining contents of the page.

The menu section is placed on the left side of the page. Mobile and smartphone users, however, can see the menu at the top of the screen to make it more readable.

Fig. 1 presents an example screen of the web page. The screen contains the section of articles. Fig. 1a) presents a screenshot taken on a computer and fig 1b) – on a mobile phone. The same page is displayed slightly different at those devices. The location and look of menu is different as well as the size of figures.

Differences between web pages adjusted to computers and to mobile phones can be also seen in Fig. 2 and 3. Those figures present mockups of the two chosen web pages. Fig. 2a) and Fig. 3a) present mockup dedicated to computers and tablets with resolution of minimal width 768 px, whereas Fig. 2b) and Fig. 3b) show mockups dedicated to smartfphones with small screens (maximal width: 767 px).

a)   b)

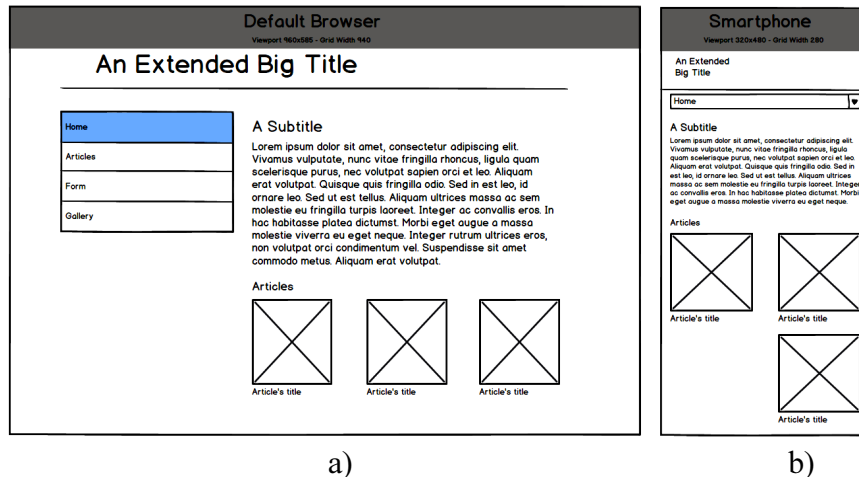Figure 1 – Sample screenshot of the web page (source: own work)

a)   b)

Figure 2 – Sample mockup of the home page (source: own work)

a)   b)
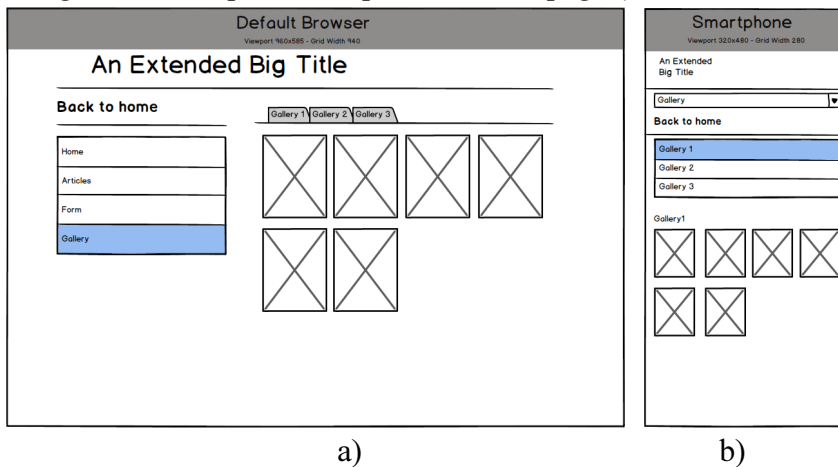
Figure 3 – Sample mockup of the gallery page (source: own work)

It is important to design the application well. One need to consider different resolutions at this stage to be sure that the displayed page will be adjusted to desired resolutions and equipments. Properly done project can be easily transformed into an application using responsive web design.

One should consider a place and layout of menu, construction of navigation and a way of pictures display.

The page is always adjusted to the screen resolution, so horizontal scroll is never displayed. The menu dedicated to mobile phones also differs – it has a form of the dropdown list and it is located at the top of the web page. Menu dedicated to higher screen resolution devices has a form of list and it is located at the left side of the web page. Also the size and location of figures is different.

2 Applied methods
2.1 Expert analysis

Expert analysis is one of the most widely used method used in application testing. Experts, while using the application, check and mark the predefined areas. Those areas are defined to help to examine application compliance with interface design guidelines (such as Nielsen-Molich heuristics [9]) and to detect potential problems.

Each of those predefined areas can be divided into several more detailed sub-areas. What is more, they usually have detailed questions assigned to help experts to cover more important aspects of GUI quality [10].

During the analysis the whole tested system is treated as a black box where only the inputs, outputs and specification are visible. Consequently, experts run only the functional testing. They focus on executing the system functions and accessing their input and output data [3]. Therefore system functionality is determined by observing the outputs to corresponding inputs and the implementation details are not considered [8].

Contrary to the widespread assumption, experts usually do not acquire better results in performing specific tasks in the tested system. They usually do not know the system before testing, they have no experience regarding this particular application. However, their expert status is based on extended experience with different kind of software. This fact, as proven by studies [11], [12], allows them to perform tasks faster than the novices and to spend less time handling the errors. Moreover, experts know user interface design fundamentals and principles.

2.2 Cognitive walkthrough

Simplified cognitive walkthrough is one of the expert methods of usability and GUI quality testing. It emphasizes the ease of interface learning as well as viewing experience during the initial contact with the system [10]. This methods might be successfully used in combination with the expert analysis method.

This method is based on few tasks, which user will perform during his work with an application (e.g. making a purchase) [13]. Each task is divided into individual steps, which are analyzed according to the following questions:
   – Does the user know what to do during the analyzed step?
   – If the action performed by user is correct, is he aware of it?
   – If the action performed by user is correct, does he feel he is getting closer to reach the goal?

The difficulty of each step is usually evaluated using a Likert scale of 1 to 5, with 1 meaning 'very easy', 5 – 'very difficult'.

In contrast to other GUI quality assessment methods, the main goal of the cognitive walkthrough is to study the flow of the processes undertaken by user.

Cognitive walkthrough method has gained its popularity due to the ability of performing relatively quick analysis at low cost. Moreover, it may be used at different phases of the application design. However, cognitive walkthrough is sometimes regarded [5] as a method which detects potential problems with the interface instead of already existing problems. Therefore, it is also used in conjunction with other general tests as an addendum identifying potential problem areas.

3   The testing method

In order to obtain the results in a web page testing, the conglomerate of expert analysis and cognitive walkthrough was proposed.

The expert analysis criteria are presented in Table1 and Table 2. Table 1 shows the detailed list of areas and subareas with questions assigned to each point. The group of main areas contains: Application interface, Navigation, Data structure and Data input. The list is a modified version of the list called "LUT list" which we proposed in [14]. Modification consists in adjusting sections concerning different devices and resolutions. Accordingly, Table 2 presents the grading scale used to assess each evaluated assessed area.

Table 1 – The expert analysis list of predefined testing areas with questions assigned

Application interface	
Layout	Is the layout readable?
	Is it adjusted to different resolutions?
	Is it adjusted to mobile devices?
	Is it consistent?
	Does it support task implementation?
Navigation	
Ease of use	Is the access to all elements of menu easy and intuitive?
	Is the use of menu easy?
	Is the localization of menu intuitive?
Menu hierarchy	Isn't the menu hierarchy too complicated?
Navigation structure	Is the navigation structure intuitive and understandable for users?
	Is the navigation well adjusted to the screen resolution?
	Is it well planned?
Screen elements	Do they support the navigation?
Data structure	
Ease of use	Is the access to all sections of an application easy and intuitive?
	Is the access to all functions of an application easy and intuitive?
Information hierarchy	Isn't the information hierarchy too complicated?
Information structure	Is the information structure understandable?
	Is it consistent?
	Is it well planned?
Data input	
Data	Is the data validated by the form elements?
	Do the forms have elements acting as hints for the input data (e.g. on format or data range)?
	Can an average user fill in the form easily?
Forms	Are they designed in a readable way?
	Are they adjusted to the mobile devices?
	Do they allow user to input all of the necessary data?

Table 2 – The grading scale applied to the expert analysis list

Grade	Description
1	Critical usability errors were observed, preventing normal usage or discouraging user from using the application.
2	Serious usability issues were encountered, which may prevent most users from task realization.
3	Minor usability issues were observed, which if accumulated may have negative impact on user performance.
4	Single minor usability issues were observed, which may have negative impact on user work quality (e.g. poor readability).
5	No usability issues influencing either user performance or work quality were identified.

The cognitive walkthrough involves three scenarios containing tasks to perform for users. They are:
– Run the web page, find the specified article
– Find and display the specified photo in the gallery
– Fill out the data form

need to performed those task and answer several questions. They are:
– The type of used device
– The screen resolution
– The type of web browser
– Number of moves to accomplish the task
– Number of mistakes
– Additional remarks

The results of analysis performed using those two methods will present the users experience and GUI quality of prepared responsive design web page.

4   Proposed analysis process

Responsive web page should be analyzed in a special way. The analysis process is recommended to be conducted by experts experienced with GUI quality analysis.

The example of the analysis process could be described using the presented application. The analysis could be composed of two steps. The first one is an expert analysis, the second one – the cognitive walkthrough. Both analyses were performed using the survey.

The first section enables to analyse the GUI quality, divided into four areas: Application interface, Navigation, Data structure and Data input.

The second section regards the cognitive walkthrough composed of three tasks. They are presented in Fig.4. According the presented BPMN (Business Process Modelling Notation) process, users have to find the specified article, find and select the specified photo in one of galleries and also fill out and submit the data form.
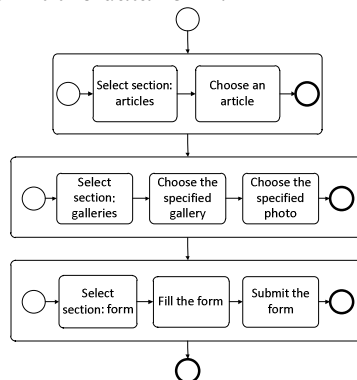

Figure 4 – The testing process of the web page (source: own work)

After fulfilling their tasks, users would be asked about their viewing experiences during accessing web page on different devices. What is more, they could give information about number of moves and mistakes they done. They should also share their opinion about responsive web design.

Summary

Responsive web design enables to create web pages, which can be viewed on different devices in similar way. Of course, due to devices diversification, it is impossible to obtain exactly the same web page look and user experience on all devices. However, the exact page look is no more desired result. The aim is to adapt the page to different users' scenarios, not for different screens. Website needs to adapt to users' interaction patterns changes.

Responsive web design helps to obtain this goal. Users do not need to install anything extra or to set any properties. They can use one common interface. However, one should be aware that the only thing certain about the future is that web design is not predictable. Its development will alway be adjusted to the technology and device trends.

Future works will include a case study on presented responsive web design project. The analysis process will regard both methods: Expert analysis and Cognitive walkthrough.

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RESUME

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The Model of Quality Assessment of Automatically Adjusted Responsive Web Pages and Applications

The main goal of the presented case study was to assess capabilities of Responsive Web Design (RWD) and to determine the user experience of RWD web pages. The case study was based on two methods (expert analysis and cognitive walkthrough) applied on web experienced users using different devices like computers, smart phones, tablets.

Obtained results confirm the effectiveness of RWD. Low number of errors and quickly completed tasks prove that RWD can be successfully applied in practice.