

Reducing the User Cognitive Load on Mobile Website Design

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Received: October 19, 2014

Accepted: December 27, 2014

ABSTRACT

The landscape of technology has changed since the advancement of smart devices such as smart phones, tablets and personal computer. Devices like smart phones, tablets and personal computers have different types of specification in screen size, thus it would be difficult to design for each and every device. This will increase the cognitive load of the users end and will reduce the attention span of the users' visual perception in gathering the right information. This is a study on the new term which is known as responsive website design. The interface of the website is based on user centric design where ease-of-use is the top priority for the user. The prototype interface was conducted via experimental methodology where a group of users were asked to use the interface and answer a questionnaire adapted from Dr. Peter J Meyer's website usability checklist.

KEYWORDS: Cognitive Load, Mobile Website Design, Mobile Devices, User Centric Interface.

INTRODUCTION

The world wide web is in the state where it is growing extremely fast with new websites appearing daily. Gone are the days where website designs were made only to be viewed by a desktop monitor screen only. With a plethora of mobile devices such as tablets and smart phones derived in our daily lives, it is the need for websites to be viewed well on mobile devices. On the other hand, the website that is built for the mobile needs to fit the normal desktop screen as well.

Responsive website design is one of the topics observed to be a bridge that can connect entire design and visual elements into one suitable interface design. The computer and device screen design plays an important role in determining the visual perception of the users. Given that estimated 90% of sites provide inadequate usability [5], steady growth in the new sites [13] and severe shortage of interface design to ensure a user centric interface [8], visual and reference are needed to accelerate and improve the website design interface.

Interface design is the connection between machine and human interaction. A definition from [10] states that the main purpose of interface in web design is "User interface is the aspect of a computer system or program which can be seen (or heard or otherwise perceived) by the human user, and the commands and the mechanism the user uses to control its operations and input data". A user centric interface plays a big role in web designing maintaining users' focus without cluttered and unnecessary information.

Web designing is derived from multimedia designing that includes simplicity, consistency and clarity of the design as well as aesthetic concern such as balance, harmony and unity [6]. When web pages fit into a screen, they are called above the fold and when extended on scrolling action, they are called below the fold. Web pages are also interactive with the addition of hypertext links which encourage the user to browse from one page to another within the site or from one site to another [9].

The web interface is a combination of several elements that work together such as text, links and graphics. The formation of the particular design element affects the overall quality of the interface design. According to [9], one important finding was that most designers viewed the web interface design as being composed of the components-information design, navigation design and graphic design as shown in Figure 1.

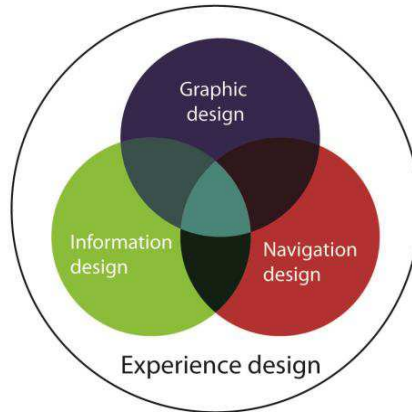


Figure 1: Venn diagram of overview on web interface design [12]

Information design emphasizes on determining the information structure of certain pages and developing a group. Navigation design focuses on the development of the navigation and how the mechanism works within the information structure. Graphic design is totally on the visual aspect of certain websites and its overall layout. All these elements are combined together to create a term called experienced design.

User Faculty

A user interface, in other words is a set of rules, methods or devices used to promote the interaction between people and machine. It is used to establish a connection between the users who are people and a machine which is a computer. The backbone in users' interface according to [4] is that it must always accomplish the same results; to enable a two-way dialogue between the user and the computer.

In order to serve the users, the interface design in the development must be user centric in nature. It must be completely user focused on the design and implementation. By all mean, the development of the interface design is to priorities the user first into account and various goals, needs and expectations when completing a task. In addition, it must also accommodate the users' aesthetic visual value and preferences.

Table 1: The user faculty matrix [4]

Faculty	Purpose	Potential Implications	User's Perspective
Visual Perception	Defines how one sees and experiences things visually, particularly with regards to shape and color.	A user with poor visual perception may not perceive the importance of a particular interface object due to its color or shape.	"Do I press on the big green thing or the small red one?"
Visual Acuity	Measures the eye's ability to resolve details.	A user with poor visual acuity may find it difficult to focus on specific interface objects or areas of within the interface.	"Where exactly do I find the 'preferences' button?"
Cognitive Ability	Defines one's ability to understand and process what they learn.	A user with relatively low cognitive ability might not be able to figure out how a given interface works, despite being given hints and other cues about how to use it.	"How the does this thing work?"
Memory Retention	Defines one's ability to retain what they have learned.	A user with poor memory retention may forget how to use an interface despite having used it successfully before.	"Which button do I press again?"
Motor Skills	Defines one's ability to physically manipulate and interact with their environment, such as moving a mouse or typing at a keyboard.	A user with poor motor skills will almost certainly encounter trouble using an interface that requires extensive mouse input, etc.	"I find moving the mouse around the screen very awkward!"
Intelligence	Measures one's ability to comprehend, understand, and benefit from experience.	A highly intelligent user is more likely to figure out how to use an interface than a less intelligent user.	<p>Intelligent User:</p> <p>"This interface is a snap to use as it's very similar to other interfaces I've used in the past."</p> <p>Less Intelligent User:</p> <p>"I can't figure this thing out. There are so many things to click and I don't know what I'm doing!"</p>

Referring to the faculty matrix, every user will possess a vast different level of visual perception, visual acuity, cognitive ability, memory retention, motor skills and intelligence. The user centric interface is divided into categories, namely the user faculties and the computer experience. The faculties directly influence the users' ability to interact with and manipulate a given interface. With careful planning and considerations on the interface design, the design can be maximized for more effective use.

In terms of computer experience, users will approach an interface in varying degrees based on the number of years they have experience in using computer. It also depends on their relative skills and how comfortable they are in utilizing computer. As computer and devices have penetrated in different age groups, the interface design has undergone a radical change.

Responsive Website Design

The website design should have the technology to automatically respond to the users' preferences. This would eliminate the need for a different design and development phase for each new gadget on the market. Each and every gadget has different specification of screen resolution. New devices with new screen size are being developed every day, and each of these devices may be able to handle variations in size, functionality and even colour. In [7] and a few of his colleagues identified statistics on about 400 devices sold between 2005 and 2008. The number of screen sizes are growing every year.

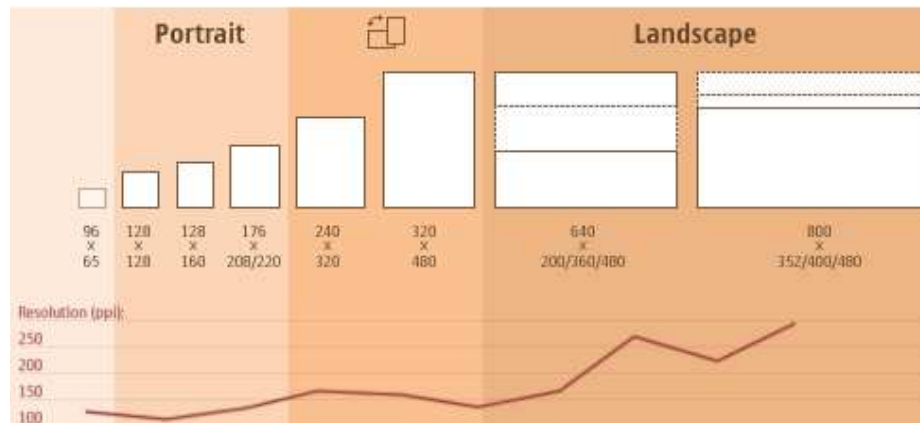


Figure 2: Screen size trends from 2005-2008

Generally, the relative screen sizes have increased. The difference between the smallest which is 128 pixels x 128 pixels and the largest 800 pixels x 480 pixels is a factor of 23. The largest screen size is 23 times bigger than the smallest. The terms of responsive website design refer to a website design that has the ability to adapt to any screen and resolutions. It can accommodate from a large normal desktop screen computer to the smallest mobile devices.

Screen Resolution Requirement

According to [13] the main ingredient that makes responsive website design a working website is responsive image, responsive grid-based layout and media queries. Responsive image ability did not exist in website design previously where the image could be adjusted proportionally or dynamically would crop the image without damaging the visual perception. Responsive website design allowed this action to be done automatically. Responsive grid-based layouts have the technique to adjust the layout to great variations of screen environment.

Previously, most of the fluid website designs that average users used worked with only the most common display resolution. Responsive grid-based layout introduced the screen resolution by having a condition to change the alternate layout to each resolution range that would enhance the viewing experience. In order to execute the responsive image and responsive grid-based layout, the cascading styling sheet refers to media queries for the requirement. It is a solution to develop a highly responsive website that can be viewed on various screens. Using media queries, a website that can be built with multiple layouts with only using one particular HyperText Markup Language (HTML) document. The site can choose the correct style sheet based on different criteria of the browser.

There are major breakdowns for screen devices [11]. As shown on Figure 3, according to the best selling smart phone and tablets, there are three major breakdowns. The desktop screen is set at a resolution of 1024 pixels.

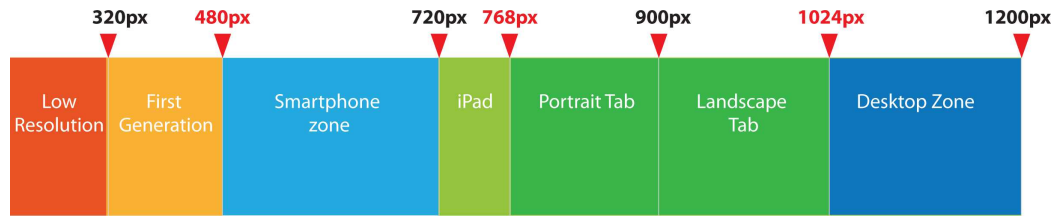


Figure 3: The major breakdowns in screen devices [2]

The major breakdown sets on 480 pixels, 768 pixels and 1024 pixels. In addition to the major breakdown, the minor breakdown is set at 320 pixels, 720 pixels, 900 pixels and 1200 pixels. To adapt the layout to the breakdown on the screen, one major rule is the use of a workable style sheet. The grid-based layouts are linearised into one column.

Screen Layout Concept

Mobile screens resolution have limited resolution in order to fit all desktop contents. The terms linearising enables the same content to fit into mobile screen. All the items are sorted out by their priority into one column where the user needs to scroll down to see the contents according to their priority. Figures 4 illustrates the linearising concept.

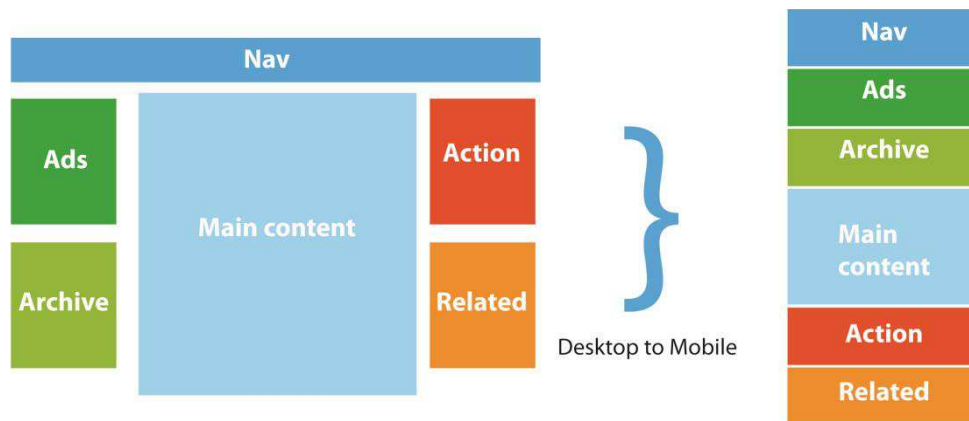


Figure 4: Linearisation on mobile screen

The navigation is put as the main priority; it is then followed by the advertisement, archive, main content and action. Some parts of the design that is on desktop will never be used in mobile contexts [1].

Responsive website design is the art of getting a website to adapt and work with all screen resolution. Having justification from the literature data, it is important to determine the based work for the prototype development. However, based on the user's point of view, a visual appearance of responsive website design is simply their preferences of any surf websites that are easily readable on smart phones, tablets or desktop computers.

From the concept of user centric interface, responsive website design enhances the visual perception at the users end, thus reducing the cognitive load by eliminating the added actions to view the site on their mobile devices.

METHODOLOGY

This section will specify the methods that were used in this study. An experimental methodology and human computer interaction (HCI) usability model approach was applied in the development of the prototype and will go through an evaluation process that is adapted from [11].

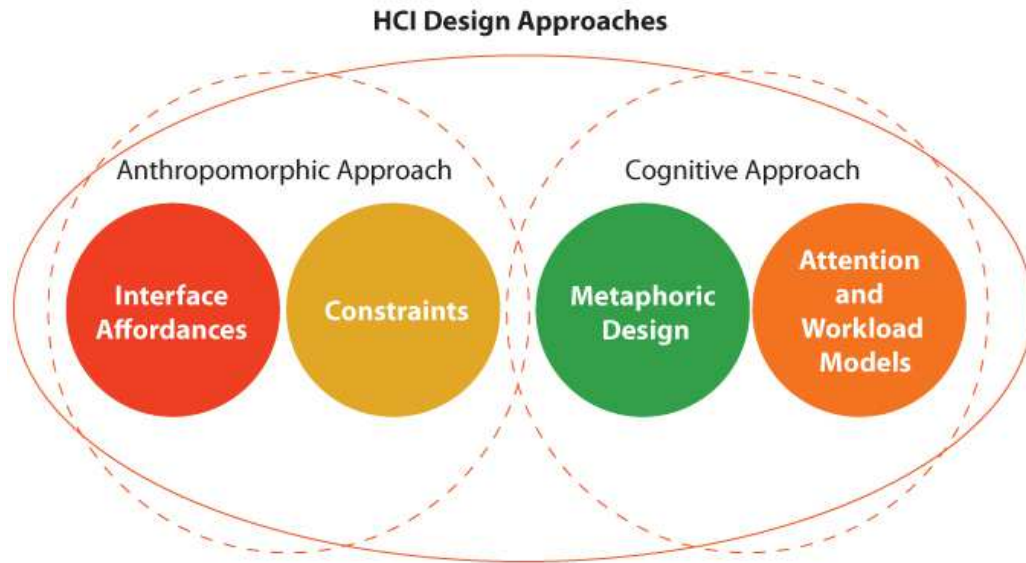


Figure 5: Categories of HCI model approaches

Figure 5 shows the logical connection of the HCI standard model: the main concern is for the design to be effective, efficient and usable when executed towards the intended context. The keypoint in executing a good and useable design is the interface and interaction. The process of designing required a user centric interface process which could be achieved with an organisational capability to support a responsive website design.

The HCI adapted model which is related to the usability is categorised with the primary attention towards:

- The interface affordances
- The user constraints
- The metaphoric process used to develop the interface
- The capability to apply attention and workload model

The anthropomorphic approach to human-computer interaction involves designing a user interface to possess human-like qualities. The cognitive approach to human-computer interaction considers the abilities of the human brain and sensory-perception in order to develop a user interface that will support the end user. One or more of these approaches may be used in a single user interface design. [3].

The researcher also reviewed the design literature to understand the historical and currently proposed research to get an idea for research design and more specifically the interface design concept.

Quantitative data collection was used in order to quantify data and generalize results from selected population. In the pre-testing evaluation, the data obtained by respondents was used to measure case-by case incidence and opinions from the visuals displayed. In addition to the quantitative questionnaire, face to face interview was also done with open-ended questions in order to gain more data.

The questionnaires were developed based on a descriptive methodology in order to evaluate the design. Descriptive methodology involves collecting data from respondents to test an interface design. Quantitative research is based on the collection of numerical data; it is used to confirm the data drawn from the analysed data [6].

Sampling for the questionnaires was done randomly in Petaling Jaya new town. The samplings targeted the youth and young adults that are more prominent in using mobile devices. The questionnaires were then distributed and answered accordingly in the form of open ended questions.

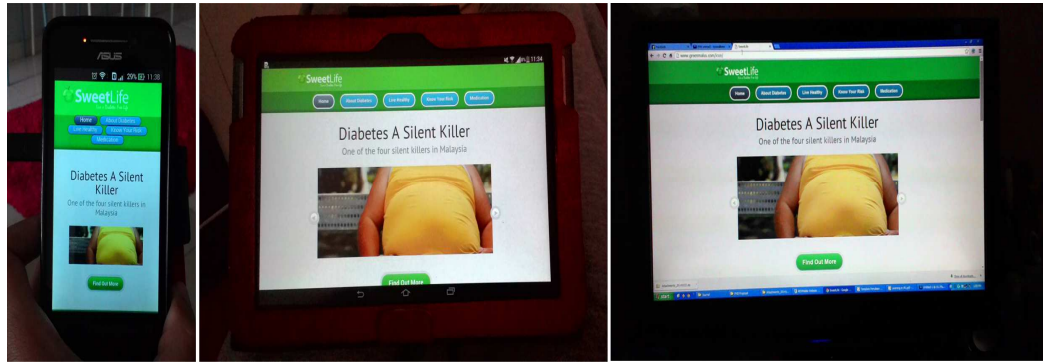


Figure 6: View of the prototype

The tools that were used in testing the usability of the prototype were a normal desktop, a mobile phone and a tablet. The devices that were mainly used for the testing were owned by the users. By using this method the gathering of data was solely from the users' end, this can eliminate the tampering data with preliminary loaded website prototype.

RESULTS AND DISCUSSION

Website Usability Testing

The main concept of responsive website design premises is to create a single website design that will adapt to the devices to view the website. The reason is to predefine the screen resolutions of the devices whether it is a smart phone, a tablet or a desktop. Following the guideline of the archival data in creating the cascading style sheet, the hierarchy of the design has to be well planned and carefully thought out in order to ensure that the user is getting the best experience in viewing the website. Therefore, it is worth designing a website that is more responsive and simply readable on a smart phone, tablet or desktop screen.

The website usability checklist is based on 5 categories. The categories are divided by accessibility, identity, navigations, content and devices. The results are as follows.

Accessibility

1. Site load-time is reasonable



2. Adequate text-to-background contrast (easy to read)



3. Font size/spacing is easy to read



4. Animation are used sparingly



5. Images & links have hover text



Figure 7: Accessibility of the website

About 93% of the respondent were able to access to the testing easily, 93% were able to read the website text, 90% identified the readability of the website text based on spacing, 84% mentioned the animations on the web were used sparingly and 84 % were all right with the use of the images.

Identity

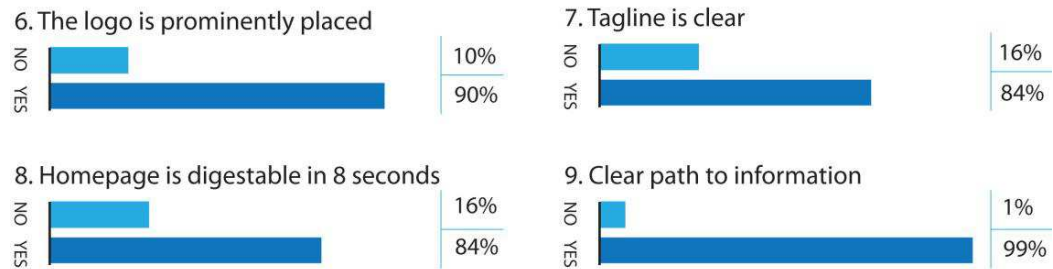


Figure 8: Visual identity

About 90% of respondents said the logo was placed correctly, 84% were able to read the tagline, 84% identified the website within 8 seconds surf on the site and 99% had clearer access to the information.

Navigations

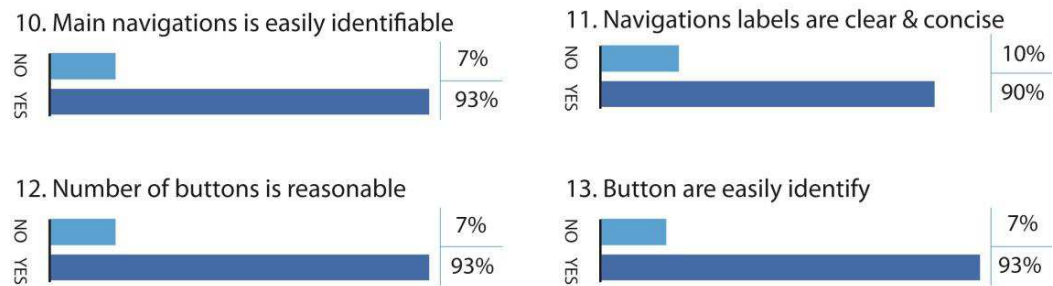


Figure 9: Website navigations

About 93% of the respondents identified the navigations easily, 90% were able to identify each label on the website, 93% agreed with the number of buttons used on the website and 93% could identify the buttons.

Content

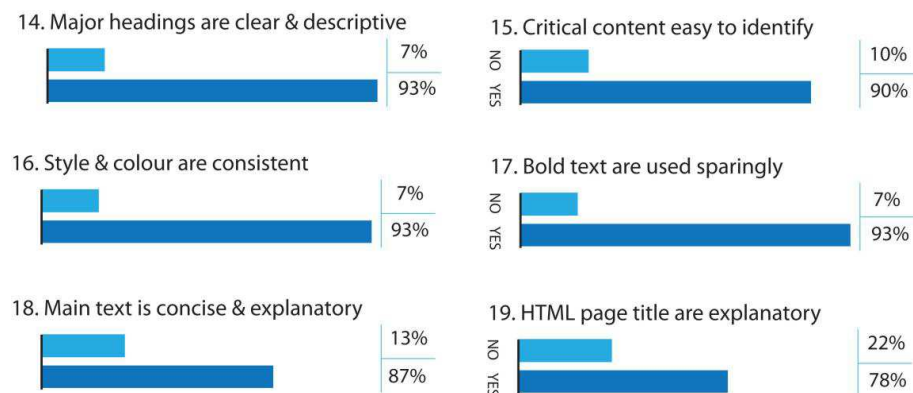


Figure 10: Website navigations

About 93% of the respondents identified the major heading clearly, 90% mentioned the critical content was easy to identify, 93% respondent agreed that the visual was consistent throughout the site, 93% agreed on the use of the bold text, 87% identified the main text used and 78% could identify the title of the page.

CONCLUSION

Website design does have the ability to deliver content via any mobile device. There is a tremendous opportunity in designing a website for the users' experience. The mobile users may become one of the primary choices in browsing the web but they have a different agenda compare to the desktop users.

In conclusion, the design of the interface can be determined by the user and can be finalized the way the user prefers it to be. The grounded theory of interface design works hand in hand with the responsive website design guidelines. It has a conscious understanding of what the user response would be towards the interface, therefore they can learn and benefit from the website design. According to Steve Jobs design is not just what it looks like and feels like. Design is how it works [12].

REFERENCES

1. Bottie, Allison (2013), 10 small tips Responsive Design, Retrieved from <http://www.splio.fr/10-petits-conseils-en-responsive-design>
2. Creamer, David (2012), Understanding Resolution and the meaning of DPI, PPI, SPI, &LPI, Publishing Consultant & Trainer
3. Eberts, R. E. (1994). User interface design. Englewood Cliffs, NJ: Prentice Hall. [2] Card, S., Moran, T., & Newell, A. (1983). The psychology of human-computer interaction. Hillsdale, NJ: Lawrence Erlbaum Associates.
4. Feldman, Ari, (2000-2006), Website Interface Design Theory: A Designer Primer
5. Forrester Research, (1999). Why most website fail. Retrieved 3 June 2013 from www.forrester.com/Research/ReportExcerpt/0,1082,1285,00.html
6. Hesketh, E A, Laidlaw, J M (1999), Quantitative Research: Designed and Produced by the Education Development Unit, NHS Educations for Scotland.
7. Hjerde, Morten,(2008) Founder at Rift Labs Retrieved from <http://sender11.typepad.com/sender11/2008/04/mobile-screen-s.html>
8. Nielsen, Jacob, (1999b), User interface directions for the Web, Communications of the ACM 42.65-72.58
9. Nielsen, Jacob, (2000), Designing web usability: The Practice of Simplicity, Indianapolis, IN: New Riders Publishing And Rober L. Mack (eds). Usability Inspections Methods, New York, NY: Wiley.
10. Newman, Mark W., and James A. Landay, 2000, Sitemaps, storyboards and specification; A sketch of website design practice. In the Proceedings of the 200 Designer Interactive Systems; Automatic Support in Design and Use, 263-274)
11. Marcotte, Ethan, Responsive website design, Retrieved from <http://alistapart.com/article/responsive-web-design>
12. Palmer, B. Sean, Master CSS pixels for Retina displays, Retrieved from <http://www.netmagazine.com/tutorials/master-css-pixels-retina-displays>
13. Walker, Rob, The Guts of a New Machine, New York Times, Retrieved from <http://www.nytimes.com/2003/11/30/magazine/the-guts-of-a-new-machine.html?pagewanted=all&src=pm>
14. Free On-line Dictionary of Computing , 2014. Retrieved from <http://foldoc.org/User+interface+>.