

# MOBILE AND RESPONSIVE WEB APPLICATIONS

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## ABSTRACT

Web technology has been a major factor of globalization for years. Modern technology has enabled web applications to be more complex because of greater data transfer speeds. Web quality is something that has come to focus as well as usability as one of its major aspects. Mobile applications have become popular since smartphones have gained greater hardware possibilities. The question that has presented itself is whether web technology can be as good as native mobile technology. The discussion about these two technologies is presented in this paper along with the research about the current popularity and utilization of responsive mobile websites.

## 1 INTRODUCTION

Web technology has been stable and reliable factor in globalization and communication for years. Rapid development of web technology has brought a wide variety of possibilities and web applications today are able to resemble classic desktop applications in great deal. With increase of data transfer speeds greater design possibilities have been enabled and usability has come to focus.

With the development of smartphones market and advancement in possibilities of mobile operating systems, the mobile applications have become more and more popular. Web technology has responded with responsive web design and rapid advancement in possibilities to mimic mobile applications. The question that has emerged is whether to develop native mobile or web applications and can web applications' interfaces really resemble mobile applications in satisfactory way.

## 2 USABILITY OF WEBSITES

Globalization as a worldwide trend is closely connected to Internet and development of web technologies. Web as a global media has become one of the most important factors of successful advertisement and other business activities. One of important questions that has been researched is the question about the quality of websites. This quality has been observed through several dimensions: design, content, entertainment, ease of use, reliability, interactivity, security and privacy. [8].

In the past years there was a lot of talk about optimization of websites because of lower data transfer speeds but today with greater speeds of data transfer there are other aspects that deserve more attention such as usability and design of user interfaces.

Many different definitions of usability can be found [4]. ISO 9241 defines usability 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]. No matter what definition is observed, they all have user at the center of their focus and satisfaction of the user as the main criteria. There are many recommendations on what should be considered to achieve usable design. One of these recommendations proposes the following three principles [5]:

- Early focus on users and tasks
- Empirical measurement
- Iterative design

Early focus on users and tasks presumes a user-centered design in which the user with his expectations is early involved in the development process. Empirical measurement and iterative design mean that developer should test and measure the effectiveness and efficiency of his solution until all issues are resolved.

## 3 INTERFACE DESIGN AND USABILITY

Another already mentioned aspect that deserves attention is user interface design. User interface includes several elements: navigation, site organization, searching ease, user-controlled navigation, links, cross-platform design, writing style, and multimedia capabilities [8].

Although websites are popular and in mass usage, a lot of them are not well designed [1]. The reason for this could be found in education system in which students of computer science are trained mostly in HTML techniques and modern website design techniques [1], which is not enough to achieve proper design quality and usability. In order to design usable websites one has to understand the site's audience, category, content, usability goals, and how to measure to achieve these goals [1].

It can simply be said that user interface design should answer the questions of who, how and for what purpose will use the interface.

#### 4 RESPONSIVE WEB ON MOBILE PLATFORMS

One of mentioned elements of website usability is cross-platform design. This means that website should be equally usable on different operation systems, different browsers but also different screen sizes and resolutions. The ability of website to adapt to different screen resolutions is today named with the term responsive web or responsive design. In earlier years the term responsive in the context of websites denoted the speed in which the website worked in the terms of human satisfaction [7]. Today, this term has shifted and its primary meaning is the ability of website to adapt its size to the available screen real estate.

This focus on websites' responsiveness is greatly boosted by another rather new industry and that is the one that deals with smartphones and mobile applications. The biggest jump in mobile applications popularity which led to exponential growth of its market was made after the Apple AppStore was launched in 2008. Mobile applications interface was somewhat different from the ones of websites and it was based on widgets, touch, physical motion, and keyboards (physical and virtual) instead on well-known WIMP (Windows, Icons, Menus, Pointer) style [9]. Smaller screens brought many restrictions and design of mobile applications was simplified and minimized in great amount providing the users with quick and simple means to accomplish desired tasks, omitting many functionalities and options that were standard in familiar web applications.

Mobile applications' user interfaces have common elements with web applications, but they are often redesigned to include only the most commonly used functionalities and to make the most out of rather small screens of smartphones as well as to utilize the mobile user interface paradigm which includes various user inputs as well as motion and location information [9].

Web technology has taken into consideration the rising popularity of mobile platforms and it has incorporated another aspect and that is so called responsive web or responsive web design. This kind of design enables website or web application to rewrap, reorder and to adapt to different screen sizes and resolutions rather than having separate mobile version of the same site or application.

In this way developer is able to design a web that will look good on all platforms and which will be more detailed on traditional monitors and more minimalistic and simple on mobile devices which is closer to mobile design paradigm. In time this same technology started to be used to create mobile web applications which are designed to resemble native mobile applications and to serve as a substitution for them. So when confronted with the need to create an application for smartphone and mobile platform, developer can choose to develop in native, web or hybrid technology.

#### 5 RESPONSIVE WEB OR NATIVE APPLICATIONS

The main question remains whether to develop a native or mobile web applications. Native mobile applications enable the developer to make the most out of platform's

technology and possibilities but on the other hand developing mobile applications is costly and time consuming process for several reasons: fragmentation, the web, control, and consumer expectations [3].

Fragmentation in mobile world is apparent. There are dozens of platforms, taking into consideration all possible variations, and developing an application which will work equally on all platforms is a very troublesome task. Web technologies are developing rapidly and web is still the area that has the most rapid expansion. Development of additional possibilities and technologies in this areas makes websites and web applications more and more capable to completely resemble native mobile applications. Web is still the only market where developer has all the control over distribution of his product to the users. Control in the area of mobile applications deployment is largely in the hand of third parties. Also, customers expect for all applications to just work fine. This is not the case in many usages of mobile applications on many devices which have problems in rendering mobile applications' interfaces or in not having enough power for fluent mobile applications performance.

All mentioned aspects are not so prominent in the case of web technologies which offer developer possibility to develop everything just once in one technology (cross-platform development) and everything else is just a matter of browsers which are today mostly compliant to new standards and thus have little problems in rendering and executing web applications. This kind of development obviously saves money and time. Another technology that boosts the usage of web mobile applications are responsive CSS frameworks such as Twitter Bootstrap [13], Foundation, Skeleton, HTML5 Boilerplate, HTML KickStart and others [15] which support easier and quicker development of web applications that have the ability to adapt to various screen sizes which is suitable approach for usage on smartphones.

The most commonly mentioned disadvantages of cross-platform development are the speed and inability to utilize the full potential of mobile hardware possibilities. For example, JavaScript code in mobile websites that are fully cross-platform oriented runs sandboxed in WebView which is one of the components that is known to be rather slow. Another problem that is associated with cross-platform development is inexistence of plugins for all needed purposes and a problem with performance when a larger amount of graphics is used. There is also a problem of getting just the right look and feel of mobile applications UI and this is the reason that some developers use the combination of cross-platform core that interacts with native view which results in better looking applications but this approach frequently lacks clear procedures and documentation that describes this kind of interaction.

Research results show that developers feel that there is no universal solution and that all possible approaches (native, web-based or hybrid) are suitable depending on particular application and its demands [14]. Research results also show that web and hybrid approaches are gaining popularity

among developers and that web technology (HTML5 and JavaScript) is developers top choice for building cross-platform applications [14].

The biggest problem for web applications was inability to utilize some features of smartphones' hardware but this is now also starting to be possible as web technology advances. One example of this is project PhoneGap [2] which uses mobile browser which can be instantiated programmatically and from this mobile browser instance it is possible to call native code from JavaScript [2]. PhoneGap enables developers to use JavaScript, HTML and CSS to develop their mobile applications and it also enables developers to use advanced mobile hardware features such as accelerometer, geolocation and camera. PhoneGap has been purchased by Adobe in 2011 [10]. Beside PhoneGap that is probably the most popular and awarded cross-platform development framework there are also several other well-known alternatives. Appcelerator Titanium [12] is very popular development environment that is Eclipse-based and that provides a single codebase mobile applications development using JavaScript. The great advantage of this platform is that it supports the usage of native UI components which increases performance of developed mobile applications. MoSync [12] is also Eclipse-like and it provides options of developing mobile applications in either C/C++ or JavaScript/HTML5 codebase. RhoMobile Suite [11] supports development of mobile applications in HTML, CSS, JavaScript and Ruby. Adobe AIR [16] uses HTML, JavaScript, Adobe Flash and Flex as well as ActionScript in order to provide means of building rich mobile applications. Other alternatives for cross-platform development include Xamarin [16] which is C# based, jQuery Mobile [10] and Sencha Touch [10] which are a HTML5-based frameworks that provide means for development of native-like web applications, Corona [12] that uses Lua programming language and Telerik AppBuilder [16] which uses HTML5, CSS and JavaScript codebase. Taking this into consideration and rapid advancement of web technology it can be presumed that in some point it will be possible to completely mimic mobile applications by using web applications and that native mobile application will be absolutely necessary just in some cases such as for example mobile games [3] which require full utilization of smartphone's hardware.

## 6 RESPONSIVE WEB DESIGN USAGE

Today, responsive web design can be used for one of the following purposes:

- To adapt web design to different monitors and resolutions
- To adapt web design to mobile browsers
- To emulate mobile applications

Currently, the most utilization of responsive design is still in the first two cases. One question that is interesting to answer is whether users actually use responsive features of websites. In the first case it is obvious that users use these

features because of different monitor sizes although in this case web design can be fixed according to smallest monitor and resolution that is currently used and this is mostly the case. As already mentioned the third case is still not so common and will be interesting topic for further research but the second case is actual and the question that can be asked is whether users use responsive feature of web design in the way that they use mobile versions of websites or web applications rather than full sites and pinch-to-zoom gestures. The answer to this question shows whether current design and philosophy of mobile websites is sufficient for average visitor or it needs further design alterations.

To answer this question an international research has been conducted on 87 random smartphone users that were approached and asked to answer several questions regarding their mobile web browsing habits. All users that didn't use smartphones were not considered. The research was conducted in Croatia and Slovenia. 54 participants from Croatia and 33 from Slovenia participated in the research. Likert scale was used in all questions (1-strongly disagree, 5-strongly agree). 62 participants were under 40 years old, 48 participants were men and 39 were women. Questionnaire items and results are given in Table 1.

Questionnaire item	Mean	Std. dev.
When I visit websites I immediately switch to full site if mobile version is loaded	3,871	0,749
I prefer mobile versions of websites over full sites	2,028	0,587
Mobile websites are easier to use and I prefer to use them over full sites	2,214	0,423
Full sites are better because of more information that can be seen at once	4,068	0,824
I don't use mobile versions of websites because they lack information and features comparing to full sites	3,687	0,642
I find mobile versions of websites easier to use because of no need to increase or decrease content	1,842	0,481
I would use mobile websites more often if they were richer in content	2,785	0,398
I prefer increasing/decreasing the content in full sites over the need to scroll in their mobile versions	3,414	0,751
I can access information more quickly in full sites than in mobile versions	4,257	0,543

Table 1: Questionnaire items and results

The results in Table 1 show that the mobile versions of websites is not something that most of visitors use. According to the research results, the reasons of this can be found in less amount of information that are usually provided in mobile versions and in longer time needed to find information by scrolling than by increasing/decreasing the content. It can be presumed that older population would prefer more simple mobile interfaces with initially enlarged content over full sites as well as more simple navigation of mobile websites which includes only scrolling through the content. This presumption is also supported by research results. Younger population with good eyesight and more dynamic way of living is more keen to use full sites and see all information at once in order to quickly enlarge or choose the content of interest.

Mobile versions of websites and web applications as well as responsive web design is something that is changing the web reality. It also enables web applications to be used on a mobile devices in almost native way and it is something that will probably be seen more and more often. At a present level of usage however, the responsive web that brings mobile versions of websites and web applications is a feature that is not used by majority of users which shows that there is a room for improvement. According to the research results it can be presumed that with further improvement and richer web mobile user interfaces that will be both richer in content and design elements that will resemble native mobile applications in a greater amount, more and more mobile websites will be in mainstream usage as they will provide equivalent experience compared to their full websites counterparts. Web technologies and responsive web is developing rapidly and more and more features can be expected in the near future.

## 7 CONCLUSION

Web technology has been used for years. With resolution of data transfer issues and various needs for optimization of websites and web applications the usability and interface design has come into focus. Along with web technology, development of more capable smartphone mobile platforms has produced its own mobile applications which have rapidly become very popular. Web technology has responded with responsive web and various possibilities to make web applications that are similar to native mobile applications. With this rapid development of web technology there is even greater meaning of the question whether developers should develop native or web mobile applications. In this paper both alternatives have been discussed along with the research that has shown that web technology in mobile world is promising but at the present moment there is still room for improvement and the majority of user still do not use mobile websites in their everyday usage. Further research about the factors that influence the amount of mobile web applications usage and further comparison of mobile and web technology and their possibilities will be a part of future work.

## References

- [1] Calongne, C. M. Designing for website usability. *Journal of Computing in Small Colleges*, 16(3):39-45, 2001.
- [2] Charland, A.; Leroux, B. Mobile application development: web vs. native. *Communications of the ACM*, 54(5):49-53, 2011.
- [3] Fling, B. *Mobile design and development: Practical concepts and techniques for creating mobile sites and Web apps*. O'Reilly Media, Inc., 2009.
- [4] Folmer, E.; Bosch, J. Architecting for usability: a survey. *Journal of systems and software*, 70(1):61-78, 2004.
- [5] Gould, J. D.; Lewis, C. Designing for usability: key principles and what designers think. *Communications of the ACM*, 28(3):300-311, 1985.
- [6] ISO/IEC, 9241-11, *Part 11: Guidance on usability*, 1998.
- [7] Johnson, J. *GUI Bloopers 2.0: Common User Interface Design Don'ts and Dos*. Morgan Kaufmann, 2007.
- [8] Song, J. H.; Zinkhan, G. M. Features of web site design, perceptions of web site quality, and patronage behavior. In *Proceedings of the ACME 2003*, pages 106-114, 2003.
- [9] Wasserman, A. I. Software engineering issues for mobile application development. In *Proceedings of the FSE/SDP workshop on Future of software engineering research*, pages 397-400, 2010.
- [10] Heitkötter, H.; Hanschke, S.; Majchrzak, T. A. Evaluating cross-platform development approaches for mobile applications. In *Web Information Systems and Technologies*, pages 120-138, Springer, 2013.
- [11] Palmieri, M.; Singh, I.; Cicchetti, A. Comparison of cross-platform mobile development tools. In *16th International Conference on Intelligence in Next Generation Networks (ICIN)*, pages 179-186, IEEE, 2012.
- [12] Hartmann, G.; Stead, G.; DeGani, A. *Cross-platform mobile development*. Tribal, Lincoln House, The Paddocks, Tech. Rep., 2011.
- [13] Rahman, S. F. *Jump Start Bootstrap*. SitePoint Pty. Ltd., 2014.
- [14] The HTML5 vs. Native Debate is Over & the Winner is..., available at <http://www.telerik.com/whitepapers/kendo-ui/the-html5-vs.-native-debate-is-over-the-winner-is>, accessed: 5th September 2014.
- [15] Gube, J. 10 Best Responsive HTML5 Frameworks, available at <http://designinstruct.com/roundups/html5-frameworks/>, accessed: 5th September 2014.
- [16] 30+ Cross Platform Mobile App and Game Development Tools, available at <http://www.tuicool.com/articles/FNZ3Yj>, accessed: 7th September 2014.