Implementing Responsive Web Design for Enhanced Web Presence

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Abstract - Modern companies, institutions, organizations, individuals, etc. have websites in order to extend their reach to audience or customers. However, it is not sufficient anymore just to have an appearance on web and to be recognized through various web search engines. People are increasingly using smartphones and tablets for accessing the Internet, not just desktop personal computers and notebooks, therefore websites need to be optimized for all these devices in order to provide the best user experience. Responsive web design provides a website with a flexibility to adapt to any of these devices, i.e. their resolutions. The paper presents statistics and predictions of market trends regarding the devices and user experiences in web browsing and m-commerce. Responsive web design is researched, along with its benefits and potential problems.

I. INTRODUCTION

A modern website is a must have tool for any company to increase its visibility towards potential customers. It is common for companies, institutions, organizations and individuals to have websites to reach audience or customers. However, it is not enough just to be present on web and available through web search engines anymore. People are spending increasing amount of time online and they are increasingly using smartphones and tablets for accessing the Internet, so websites need to be optimized for all these devices in order to provide the best user experience. Besides various screen sizes and resolutions, different web browsers and platforms, some differences also exist in the ways users interact with their devices: using a mouse, touching the screen or making movements.

Internet became accessible virtually to anyone and anywhere. However, a number of websites are still not optimized and viewable for all the devices that can be used for web browsing, mainly due to the technology used for website creation.

While some web technologies are near extinction (e.g. Flash), new technologies and web standards are in their rise (e.g. HTML5 and CSS3) to allow websites better adjustment and visibility.

In several articles and popular sites [1] [2] [3] that discuss web design trends, year 2013 has been declared as the year of responsive web design. Predictions are that such web design will be one of the biggest marketing trends in 2013. Responsive web design is a new web design approach that enables flexibility of a website to adapt to any device.

II. WHY DIFFERENT DESIGN IS NEEDED?

Following research results and predictions indicate that a change in traditional web design is needed to meet the market needs.

A. Device Market

According to Gartner's research report with shipments projections for smartphones, tablets, ultramobiles and PCs from 2012 to 2017 (Table I) [4], the combined shipments of PCs, tablets and mobile phones is expected to grow 9% to total 2.4 billion units in 2013 from 2012. In 2012, more tablets and smartphones were sold than PCs. Sale of desktop PCs and notebooks is expected to decline 7.6 % in 2013, while the shipments of tablets and smartphones are expected to grow. The most significant growth is projected for tablets: worldwide shipments are predicted to 197 million units in 2013, which is a 69.8% increase from 2012 shipments of 116 million units.

Device shipments are predicted to continue their growth, reaching more than 2.9 billion units in 2017.

With time, besides having the greater number of total devices, the proportion of particular devices will significantly change: there will be less PCs and more tablets and smartphones. There is a significant shift from PCs to mobile devices in these projections.

Similar research was conducted by International Data Corporation (IDC) [5]. Table II shows their results and predictions. They expect that tablet shipments will surpass desktop PC shipments in 2013 and notebook shipments in 2014.

TABLE I. WORLDWIDE DEVICES SHIPMENTS BY SEGMENT, 2012-2017 (THOUSANDS OF UNITS) [4]

Device Type	2012	2013	2014	2017
PC (Desk-Based and Notebook)	341,263	315,229	302,315	271,612
Ultramobile	9,822	23,592	38,687	96,350
Tablet	116,113	197,202	265,731	467,951
Mobile Phone	1,746,176	1,875,774	1,949,722	2,128,871
Total	**2,213,373**	**2,411,796**	**2,556,455**	**2,964,783**

TABLE II. SMART CONNECTED DEVICE MARKET BY PRODUCT CATEGORY, SHIPMENTS, MARKET SHARE, 2012-1017 (UNITS IN MILLIONS) [5]

Product Category	2012 Unit Shipments	2012 Market Share	2017 Unit Shipments*	2017 Market Share*	2012—2017 Growth*
Desktop PC	148.4	12.4%	141.0	6.0%	-5.0%
Portable PC	202.0	16.8%	240.9	11.0%	19.3%
Tablet	128.3	10.7%	352.3	16%	174.5%
Smartphone	722.4	60.1%	1,516	67%	109.9%
Total	1,201.1	100.0%	2,250.3	100.0%	87.3%

* Forecast estimates

IDC's and Gartner's results show small differences in their projected numbers but the trends of device market changes are common in both their projections.

B. Web Browsing, M-commerce and User Experiences

Web browsing through mobile devices has covered 10.11% of website page views in May 2012 [6]. Mobile internet usage continues to grow. According to TechCrunch [7] and Gartner [8], more people globally will have access to the Internet through mobile devices rather than through desktop computers in 2013. IDC predicts that by 2015, more Internet users will be accessing the Internet through mobile devices than through PCs in the U.S. [9].

Consumers use a variety of devices to reach different goals on the Internet (e.g. browsing the Internet, shopping online, managing finances). Google's research shows that 90% of people use multiple screens sequentially [10], i.e. move between devices.

Since the increasing number of people own mobile devices, more and more companies adapt to mobile Internet usage. By 2016, mobile commerce is expected to grow to 5 times of its current size [8].

According to Google's research of users' expectations and reactions towards their mobile website experiences, 67% of users are more likely to buy a product from a mobile-friendly site so mobile-friendly sites can turn users into customers [11]. Mobile users are five times more likely to abandon the task if the site isn't optimized for mobile usage and 79% of mobile users will search for another site to complete the task [8]. If a company doesn't have a mobile-friendly site, both company's reputation and potential profit are affected, and users will turn to competitors' site.

More statistics about mobile commerce, mobile web, mobile marketing, consumers, mobile payment, etc. can be found in [12] and [13].

III. MOBILE-FRIENDLY WEBSITE CREATION APPROACHES

Content on the web should be accessible everywhere, anytime and with any device: personal computers (desktops and netbooks), smartphones, tablets and televisions. How can it be achieved?

One approach to create mobile-friendly website is to create separate (two or more) versions of the same website, e.g. one for desktop computers, one for mobile phones and one for tablets. For each type of site, different URL is given. If a website, which has a mobile and a desktop version, is accessed on tablet, a mobile version of the website will most likely be loaded. Tablets are bigger than smartphones and that version of website is not optimized for them. When having multiple versions of websites, updates need to be executed on more than one place, thus a greater possibility for errors exists.

In most cases, a better approach would be to create one website based on responsive web design principles that works correctly on all devices and resolutions that exist today, and is also ready for the future devices. Once the code is written, it can be run on any device, which is a better option than building separate websites for each device. "A huge trend in 2013 will be that most e-commerce retailers will be using responsive web design." [14]

IV. RESPONSIVE WEB DESIGN – KEY FEATURES

The term "responsive web design" was first used and explained by web designer Ethan Marcotte in 2010 [15]. "Responsive web design is the approach that suggests that design and development should respond to the user's behavior and environment based on screen size, platform and orientation." [16]

Responsive web design implies a different way of thinking, i.e. a slight change in web design philosophy. A responsive web page has one URL, one HTML code and its content is shown according to the defined CSS3 media queries on multiple devices (desktop PCs, notebooks, smartphones, tablets and televisions). It will automatically scale and adjust content to various screen sizes. The aim is to achieve readability and navigation on any device with minimum of resizing and scrolling.

Key features of responsive web design are:

- a flexible (fluid) grid,
- flexible images and
- CSS3 media queries [17].

Flexible grid consists of columns expressed in relative widths (e.g. percentages, ems), as proportions of their containing element, rather than in fixed, inflexible pixels. The grid is resizing as the viewport (the area available for viewing the web page) is changing.

Flexible images move and scale proportionally (shrinking or enlarging) as their flexible container resizes. Besides the approach of resizing images according to the screen size, there is also an option to create multiple

versions of an image for different resolution ranges or an option to crop images.

Media queries are a module from the CSS3 specification that allow building multiple layouts using the same HTML documents. They are conditional statements that can identify not only media types (screen), but can also inspect the physical characteristics of the device and the browser that render targeted web page, e.g. the browser width, orientation. Style sheets are selectively served based on the device and browser features. Each media query has two components: a media type and the query. The query consists of the name of the feature and a corresponding value. All web browsers support CSS3 media queries. Some older web browsers lack media query support, but there are some alternative solutions that could be used for those particular browsers (JavaScript).

The most commonly used media feature is width. Figure 1 shows an example of a simple media query. Using max-width and min-width for checking resolution ranges below or above the certain breakpoints, enables conditional usage of parts of CSS designed for those ranges. Breakpoints are moments, i.e. certain pixel width ranges on which one responsive size range with corresponding layout changes to another [18]. Usually, browser's viewport dimension is taken into account, rather than device's screen size.

As the web browser width is changing, style, layout and proportions of the website content change as well so users can enjoy a seamless experience on any device [19]. Figure 2 shows a responsive website on several devices.

A. *Mobile First and Desktop First Responsive Web Design*

There are two approaches for implementation of responsive web design. In mobile first and desktop first responsive web design approaches, designing starts at reference resolutions and with use of media queries adapting to other resolutions. Main resolution breakpoints and a content that will be shown on a web page in various ranges of resolutions should be defined.

In mobile first approach, by default, a layout appropriate for smaller screens is defined and then the design is progressively enhanced as the resolution increases. On the other hand, desktop first methodology takes desktop resolution as starting point and gracefully degrades design as the resolution decreases.

Modern websites are being designed for more devices and more resolutions than ever before. Responsive web design is "the only durable, flexible and future-proof approach to building websites for today's multi-screen world" [20]. The process of responsive website creation is less linear than traditional website creation. Designing and building a website based on responsive design involves more collaboration between designers and other team members (e.g. front-end developers) than before. Unlike traditional website designs, workflow of responsive web design is a somewhat different. Main phases (planning, design, development and delivery) are interlacing and iteratively repeating.

```
@media screen and (max-width: 768px) {
    body {
     font-size: 100%;
    }

}
```

Figure 1. An example of a simple media query

V. Benefits of Responsive Web Design

Benefits of the implementation of responsive web design can be divided in three categories regarding to whom they are referred: benefits for webmasters, benefits for developers and benefits for end users.

Key benefits of implementation of responsive web design are one, content focused, device-independent website, long-term money and time savings, easy maintenance, better Search Engine Optimization (SEO) managing [21], more consistent user experience and usability.

Responsive websites have a single URL (one web) serving the same HTML for all devices so maintenance and updating content is easy. Changes and content editing can be made in one place (e.g. through a single CMS), unlike updating a separate desktop and mobile site. Having one URL is very important for sharing on various social networks, especially since social networks are often accessed through mobile devices. In that way, visitors can go directly to a website regardless of the device they are using.

Google recommends the industry best practice of using responsive web design [22], which is another reason for implementation.

With increasing number of devices and platforms for web browsing, building the site based on responsive design will maintain flexibility and better user experience. Responsive site enables consistency, keeping the same look and feel throughout all devices. Having a better user experience as a competitive advantage, more customers will become loyal, improving company's market share [23].

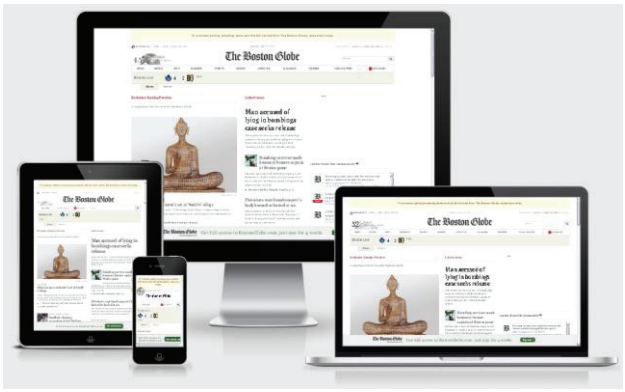

Figure 2. The Boston Globe's website loaded on several devices; an example of responsive web design

VI. Downsides And Potential Problems

Responsive web design projects are more time consuming to create and will cost about 10-20% more upfront than regular websites [24]. However, there is no need for a separate mobile site.

Some mobile devices and web browsers are not compatible with CSS media queries so alternative solutions should be taken into account for those devices. Web browsers are not uniformly supporting new web standards. Some sites have complex modules that won't function or would be hard to use on smaller devices. Responsive images are an unsolved problem of responsive web design and there have been many attempts to solve it [25]. One solution could be serving lower size images to smaller screens.

Most users expect a web page to load in less than 4 seconds [26]. Slow loading of a web page on mobile devices is the biggest performance problem for many responsive sites, mainly because of over-downloading (e.g. download and hide or shrink images, extra CSS download). Larger or unnecessary images can impact loading time. Page size and HTTP requests should be reduced for faster page load and better performance.

Guy Podjarny has conducted performance test on 347 responsive websites in March 2012 and 2013 [27]. Despite a fact that website changes its look across different screen sizes, the weight and load time of the website hardly changes. Figure 3 shows differences between page size on smallest and largest screens in the test conducted in 2013. Despite a fact that mobile version of responsive site was loaded on smallest screens, majority of the sites have roughly the same size (72%) on the smallest and on the largest screens. Comparing the results from 2012 and 2013 tests, the average page in 2012 weighted only 6% less on a small screen than on a large screen, compared to 9% in 2013 (Figure 4). The results are not good, but a slight improvement is evident.

During the designing and deployment process, the performance should be kept in mind, and website should be kept as lightweight as possible to ensure a good user experience [28].

Responsive web design is not so suitable for the

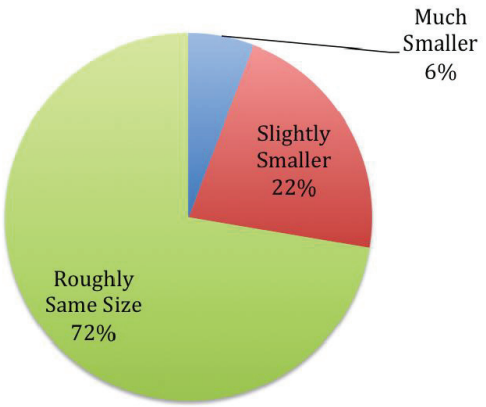

Figure 3. Page size, smallest resolution vs. largest resolution [27]

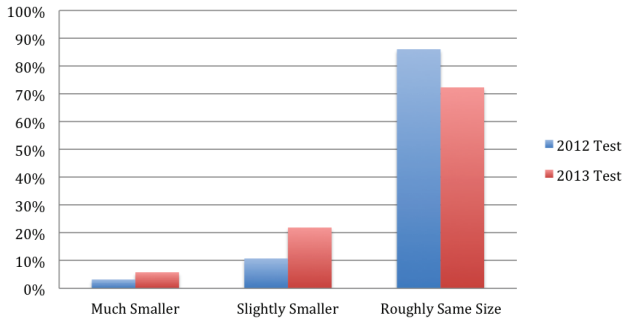

Figure 4. Page size, results from 2012 and 2013 [27]

advertisers. It is harder to place banner advertisements within a responsive design [29] than in fixed width design.

In some cases, it is better to have a separate desktop and mobile site than having one responsive site. For most organizations, implementation of responsive web design will yield improved results and long-term savings and with other benefits will outweigh any negativity [30].

VII. Conclusion

It is hard to keep up with the different devices and resolutions on the market. Responsive web design adapts the web page to different screen sizes and it is also prepared for the future-devices that haven't been released yet. Along with greater number of mobile devices, the importance of responsive web design is also increased.

Mobile devices are changing the way that commerce works. It is important for a business or a commerce website to be optimized for optimal viewing experience, reading and navigation with minimum of resizing. Implementation of responsive web design can result with greater number of visitors, increased sales and customer satisfaction.

More work should be done in defining standards and best practices of responsive web design and finding the ways for improvements (e.g. better responsive web design performance and responsive images).

There are many examples of successful implementation of responsive web design, and its implementation increases on daily basis. Responsive web design is becoming the standard of present web design. It can be concluded that responsive web design has a promising future, and will continue to develop.

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