

Web Usability Guidelines For Smartphones: A Synergic Approach

Desmond Lobo, Kerem Kaskaloglu, ChaYoung Kim and Sandra Herbert

Abstract—The mobile phones that we carry with us all the time have started becoming increasingly sophisticated and consequently are referred to as “Smartphones”. Smartphones today are extremely powerful and, in addition to making phone calls, are capable of performing a variety of other functions. One very important function is the ability to access the Internet for a wide number of purposes.

An obstacle that these users face is that access to the Internet is through a tiny interface, which is in sharp contrast to the typically large, flat-screen monitor. Unfortunately, many websites are neither designed for nor suitable to be accessed from these small devices. With relatively little effort, however, the developers of the websites can make the web interfaces more appropriate for Smartphones and hence accessible to a much larger audience.

In this paper, we focus on “web usability”, a term essentially concerned with the ease of accessing and entering information on websites. We compile and synergize several different guidelines with the intent of increasing the web usability of Smartphones.

Index Terms—Mobile Devices, Smartphones, Synergic Approach, Web Usability.

I. INTRODUCTION

We carry our mobile phones with us all the time. Because these devices started becoming increasingly sophisticated, the term “Smartphone” emerged. Today’s Smartphones are extremely powerful and, in addition to making phone calls, are capable of performing a variety of other functions. One very important function is the ability to access the Internet. Users of Smartphones regularly conduct online activities such as carrying out banking transactions, engaging in e-commerce, browsing informative web portals, taking advantage of gaming and other leisure sites, and many more.

An obstacle faced by these users is a tiny interface through which they must access the Internet. Currently, it is difficult to access many websites from these small devices since they are usually designed to be viewed on to a large, flat-screen monitor that would be available on a desktop computer. It is possible, with relatively little effort, for developers of the websites to make the web interfaces more suitable for Smartphones and hence accessible to a much larger audience.

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This paper discusses various different heuristics with respect to the web usability of Smartphones and begins with a description of the evolution of Smartphones (see Section II). In addition, some recent statistics regarding these Smartphones are also provided in this section. In Section III, the concept of web usability is defined and an explanation of the reason web usability is considered a difficult concept for Smartphones is provided. Some of the limitations of these phones are also highlighted in this part of the paper. Section IV synergizes various web usability guidelines for Smartphones with the objective of producing strategies that developers can pursue. Finally, the conclusion recaps the main ideas of this article and outlines plans for our future research.

II. SMARTPHONES

A. Evolution of Smartphones

The Smartphone of today is the result in advances in mobile phones over many years. It began in 1992 and has continued to develop as manufacturers compete for market share. The first true Smartphone was designed by IBM in 1992. It was made available to the public and sold by BellSouth the following year. In addition to its mobile phone capabilities, the device also contained a calendar, address book, world clock, calculator, note pad, email, games, and the ability to send and receive faxes. It was a highly advanced piece of equipment for its time. [9]

Following this initial move to include more functions in the standard mobile phone, Nokia released its first Smartphone in 1996, the Nokia 9000. A later version of this model, the Nokia 9210, also included the first colour screen. The 9500 Communicator was Nokia’s first cameraphone and WiFi phone. A modified version of the Communicator, the E90, included a built-in GPS system.

Other producers of Smartphones sought ways to differentiate their product from earlier models and manufacturers. In the year 2000, Ericsson released the touchscreen Smartphone R380, which was the first device to use the new Symbian operating system [10]. During the following year, Microsoft announced that it would be offering a Windows powered Smartphone [11]. In early 2002, Handspring released the Palm OS Treo Smartphone. This device utilized a full keyboard and included wireless web browsing, email, a calendar, and a contact organizer [12]. Later that same year, RIM released the first BlackBerry, which was the first Smartphone optimized for wireless email use [13].

Following the popularity of the touchscreen innovation, Apple released its first iPhone in 2007. This phone was one of the first to be predominately controlled through its

touchscreen. The following year saw the release of the Android operating system for Smartphones. Android is an open source operating system that is backed by Google. A couple of years later, in January 2010, Google then launched the Nexus One Smartphone that was powered by this Android operating system.

B. Smartphone Statistics

Like all innovations and developments in technology, Smartphones have been experiencing rapid growth in the last few years. According to Gartner [8], Smartphone sales now account for almost 20% of total mobile phone sales. Some of the very recent statistics involving Smartphones are quite striking:

- Coda Research Consultancy [6] forecasts that worldwide sales of Smartphones will total 2.5 billion units in the period from 2010 to 2015. The Asia Pacific region and the Americas are each expected to generate sales of 0.8 billion units. Coda Research Consultancy also expects that mobile Internet use via Smartphones will increase 50 fold by the end of that period.
- Juniper Research [4] predicts that the number of subscribers using mobile Internet services will reach a whopping 1.7 billion users by 2013, with the Far East and China region making up the largest market for the mobile web. This area alone will account for almost 416 million users.
- According to Forrester Research [5], small business owners seem to be setting the pace for Smartphone adoption in the US. While only 17% of Americans currently own Smartphones, a massive 49% of small business owners are reported to possess these devices. The phones are being used for everyday business needs such as such as making calls, email, scheduling, tweeting on the go, mobile advertising, location-based applications and other business applications.
- Morgan Stanley Research [7] estimates that sales of Smartphones will exceed those of PCs in the year 2012.

The statistics above all lead to one obvious conclusion: SMARTPHONES ARE IN! At the core of this exponentially increasing demand is the desire and requirement for handset subscribers to access the Internet anywhere and anytime. To take full advantage of this inevitable growth in the Smartphone industry, developers of websites therefore need to ensure that their sites have been designed to optimize the number of users able to access their sites; they need to cater for Smartphone users as well. Web usability for these phones is covered in the next section.

III. WEB USABILITY

A. Definition of Usability

“In the emerging electronic environment, knowing how to create customer-centered Web sites is of great importance” [28]. According to the Web Communications and New Media Division in the U.S. Department of Health and Human Services [1], usability refers to how well users learn and use a product in order to achieve their goals and how satisfied they

are with that progress. Jacob Nielsen is considered by many to be the world’s leading expert in this field and has been even been dubbed by the New York Times as “the guru of Web page usability” [2]. Nielsen pointed out that usability is defined by five quality components [3]: Ease of Learning, Efficiency of Use, Memorability, Error Frequency and Severity, and Subjective Satisfaction.

1) Ease of Learning refers to the demands placed on new users in learning to accomplish basic tasks. Due to the increasing complexity and number of additional features now found in Smartphones, many users do not take full advantage of all features, often restricting their use to just making phone calls. This is especially true of Internet applications due to the problematic interface.

2) Efficiency of Use refers to the speed an experienced user of the system accomplishes basic tasks. In the business world, especially, any opportunity to conduct business in a more time-efficient manner leads to gains in productivity. The extent to which company personnel seize the opportunity to complete business related tasks when not in the office sitting before a desktop computer is seen in the statistics mentioned in the previous section. When so many small businesses (49%) own Smartphones it is imperative that they are able to use them to their maximum potential by accessing business-related Internet facilities.

3) Memorability refers to the ease at which users can remember the operation of a device when users return to it after a period of disuse. An important factor is the ease of which they can re-establish proficiency. As Smartphones become more complex, this issue may emerge as a limiting factor in the inclusion of additional features. Other design factors may become more important, such as the degree of intuitive operation of the existing features.

4) Error Frequency and Severity refers to the frequency, number and type of errors made by users. The type of error determines the ease at which a user may recover from the error. These factors impact on users’ subjective satisfaction, which is explained in the next point.

5) Subjective Satisfaction refers to the degree of contentment the user feels about using the system, since errors increase the time to complete tasks. In addition, frequent errors and difficulty recovering from them add to user frustration levels, especially when attempting to access Internet-based applications.

In terms of the Internet, usability refers to the ease by which a website can be used. It is an important concept in web design involving the generation of websites which are easy to use and navigate and aesthetically pleasing to the eye, so that users take pleasure in using the site and are able to find relevant information. High website usability is crucial for businesses to build loyalty and attract customers, as people immediately leave the site if they find it difficult to use, if they find it hard to read or if they get lost. Flavian et al. [27] report that “greater usability was found to have a positive influence on user satisfaction”. A website that is rated highly in terms of usability is an absolute necessity for a company’s survival. The design of websites with high usability involves a focus on the user. Such a site will incorporate design features which meet users’ requirements and encourage site loyalty.

Site functionality also impacts on usability and site loyalty. If a website has features which do not work, such as broken

links and images that don't load, users will find it unsatisfactory. It is very frustrating to click a link only to find it is broken. More annoying still is completing an online form which cannot be successfully submitted.

Navigation is particularly important in website usability. The logical design of a website directly impacts on its appeal to users. A site which is hard to move around, with required applications and information that are difficult to locate, will frustrate many users sufficiently enough for them to leave the website and conduct their business elsewhere.

Flavian et al. [27] claim "that the trust of the user increases when the user perceived that the system was usable and that there was a consequent increase in the degree of website loyalty". Another reason why users often leave a site is if the homepage does not clearly state the site's objective. If the user is not able to obtain the information that he or she is after, the user won't hesitate to move on to another site as there are always plenty of other options available. "Understanding their [customers] expectations and how they feel about the websites they use is becoming a very serious concern. A company's continued success comes from two groups: new customers and repeat customers" [28]. A good looking site which is attractive to users and easy to read contributes to its usability. A cluttered, illogical design may be off-putting and result in users deciding not to persevere with it. Sites should be accessible to everyone, regardless of age. Interesting visual features may make using a site difficult for visually impaired users.

B. Limitations of Smartphones

There are some limitations inherent in Smartphones (such as a small screen size, download delays, inaccessible Flash content and awkward input) that make it difficult for developers to create usable websites.

1) Small Screen Size:

On desktop and laptop computers, users are able to view content sized for easy reading. In addition, it is possible to open more than one window at a time, and this allows for multi-tasking. The small screen size on Smartphones restricts the amount of information that can be displayed at any one time. Multitasking is not possible and it is also often difficult or impossible to read text and view graphics on small screens. Usually, a user is required to scroll around the content, being only able to view small sections of a webpage at a time. This makes it difficult for the user to obtain an overall view of the webpage and very hard to locate and understand required content. This is particularly frustrating when attempting many desired online activities such as, banking transactions, e-commerce, browsing for information and leisure pursuits.

2) Download Delays:

On most mobile devices, download speed is definitely a major factor. Often, access to the Internet on these devices is even slower than dial-up. The time it takes for a website to download may influence the user's willingness to stay on the website. Nielson [29] claims that users are more likely to lose interest in a site if the download time exceeds 10 seconds.

3) Flash:

Flash content is currently not supported on most Smartphones. Many sites, especially those focusing on e-commerce, often include Flash-based applications; so, if a user attempts to access one of the "All Flash" sites out there,

for instance, he or she would be left staring at a blank page!

4) Awkward Input:

Most mobile devices do not use a mouselike pointer and this makes it difficult to click on menus, buttons and hyperlinks. Instead, navigation is enacted via scrolling and selecting. Scrolling is also more tedious and error-prone. Furthermore, entering text is generally much slower, even on devices with dedicated mini-keyboards.

These limitations with Smartphones means that developers of websites must pay particular attention to ensure that users will still enjoy a rewarding experience when visiting their website. Based on her results, Selvidge [30] advises that "further support is provided for designing websites that decrease download time, such as limiting unnecessary graphics. The longer the wait for pages to load, the greater the frustration, which could lead users to quit the task or try another site to find information".

IV. WEB USABILITY GUIDELINES FOR SMARTPHONES

The inevitable shift towards Smartphones for mobile phone users was described in Section II of this paper. Next, in Section III, some of the web usability issues with respect to these Smartphones were discussed. In this section, we synergize various web usability guidelines for Smartphones and generate a list of essential rules that developers of websites will need to follow to ensure the highest usability for their websites.

1) Keep it Simple [14, 15, 16, 17, 18, 20, 23, 24]

Make sure that actions are uncomplicated and user-friendly. Remember that most mobile users will not be willing to fill out long, time-consuming forms. They will also not want to go through a difficult and complicated process for ordering items.

Due to lack of screen space and slower Internet connections, websites for Smartphones should be designed without large images and flash content. It is also important that visitors to the site should have immediate access to the most crucial and essential information.

2) Simplify User Input [17, 19, 24]

The lack of a proper keyboard means that users need to be allowed to make selections instead of keying in input. Entering text on a Smartphone is painstakingly slow and error-prone, so having appropriate easy to operate links can be much more effective.

Furthermore, giving users the option of scrolling and browsing through a website is often easier than forcing them to search the site for some particular information or item. Entering text into a search box may be problematic for many visitors to the website as they often make errors in typing and this leads to inappropriate search results.

3) Scroll Vertically Only [15, 18, 21, 22, 23]

Since Smartphones have a limited width, it is important to design the website so that the users will not have to scroll horizontally. Scrolling vertically on one of these mobile devices is challenging enough, so scrolling in two dimensions is even more difficult and very frustrating.

4) Multiple Versions of the Website [14, 15, 16, 17, 19, 21, 22, 23, 24, 25, 26]

It is not feasible to design a website for both desktop computer and Smartphone users because website layouts for

large landscape PC screens are usually difficult to use on small mobile phones. Therefore, it is important to create additional versions of the site so that the Smartphone user may select the version which best meets his or her needs. These alternate versions need to be designed so that they are compatible with most Smartphones.

Automatic detection of whether the website visitor is accessing a site via a mobile device or a standard desktop computer may allow the visitor to be redirected to the appropriate site depending on the platform that has been detected. Although there are a variety of different mobile devices on the market, and it is almost impossible and inefficient for a website to attempt to detect all of them, there are only a few popular brands that dominate. Typically, the different models of a mobile brand have a specific screen resolution and similar capabilities. So, it is usually sufficient to consider just the most popular models.

For example, the following piece of PHP code at the top of your PHP page can detect whether the user is accessing the website using an iPhone, iPad, Android, Blackberry, Palm or OperaMini browser and whether the device employs Windows mobile or not:

```
require_once('mobile_device_detect.php');
$mobile = mobile_device_detect();
```

Another option would be to use JavaScript in your site; for instance, the following code will determine if the device is Android operating system based (for identifying Google Smartphones):

```
var deviceAndroid = "android";
function DetectAndroid()
{
    if (uagent.search(deviceAndroid) > -1)
        return true;
    else
        return false;
}
```

Furthermore, it might be useful to keep a link (possibly in the page footer) to the desktop version of the website. Giving your visitors the option of skipping to the standard site is also handy for users with a desktop computer that accidentally stumble across the mobile version of the site.

5) Native Apps Versus Mobile Webs [36,37,38]

Jakob Nielsen points out that the native applications (apps) have much higher usability than the mobile webs for three reasons [36]. One reason is that apps can be optimized for the specific hardware on each device. The Android app, for instance, is tailor made for Android, but the average mobile website is not. Some areas such as shopping and services prefer the mobile web. With the massive popularity of Wimepeu and Timon, social commerce sites are springing up in South Korea. Users enjoy social mobile commerce (mCommerce) on mobile apps or mobile webs. Mobile webs are superior in case of mCommerce. Wimepeu users have to place an order using the Wimepeu mobile app and payment is made by logging on to the Wimepeu website. Timon users, on the other hand, can place an order and make the payment using the Timon mobile web all at one go. Since it is extremely important for mCommerce to be easy, the development of mobile-optimized web by using a mobile javascript framework such as Sencha Touch may be considered necessary [37]. Gartner believes that this will be

the case in the near future [38].

6) Avoid Repeating the Navigation [14, 17, 20, 22, 23, 24]

Screen space is precious on Smartphones and navigation components can consume a large chunk of this area. It is thus advisable that the navigation should only be displayed on the homepage. On other pages, having a link back to the homepage would be convenient for visitors. A breadcrumb trail is an effective substitute for repeating the navigation on every page.

V. CONCLUSIONS AND FUTURE WORK

Without a doubt, Smartphones are the way of the future. Developers of websites need to take note and consider the web usability of Smartphones when designing their sites; otherwise, they risk losing a large portion of potential visitors. In this paper, we have discussed various different heuristics related to the web usability of Smartphones with the intention of providing website developers with effective strategies for the design of websites to take into account Smartphone users. The description of the evolution of Smartphones and the statistics provided on Smartphone use indicate that consideration of Smartphones in the design of websites will become increasingly important. Web usability is defined and its application to Smartphones explained.

In the next stage of our research, we plan to look at the impact of rootkits on these Smartphones. Rootkits refer to software that is used to conceal the presence and activity of viruses, worms, Trojans and other forms of malicious software (malware). They also permit an attacker to take control of an operating system [32]. In fact, installing a rootkit is usually the first thing that an attacker will do after gaining access to a system, as this will ensure that the attack will remain undetected [34].

Rootkits often open a backdoor through which the attacker can spy on the system's activities [35]. The attacker can then proceed to capture personal data, such as bank account details, passwords, and credit card numbers. There exists an active underground economy that trades in these stolen digital credentials [33].

A group of researchers at Rutgers University have already demonstrated that Smartphones are just as vulnerable to rootkit attacks as desktop computers [31], and it is simply a matter of time before actual rootkits are detected on these devices. Once rootkits start invading Smartphones, the tools that are currently available for combating rootkits would need to be adapted for these phones. It is therefore essential that further research be conducted into the impact of rootkits on these Smartphones.

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