

Mobile Web Usability: Developing Guidelines for Mobile Web via Smart Phones

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Abstract. More people have their smart mobile devices, more they access web sites via those devices. However mobile web users are not satisfied with experience of mobile web. What are the problems that users confront as they use mobile web? What are the design patterns of existing mobile web sites and what could be the recommended pattern among them? In order to answer these main questions, three different studies have executed: 1) task analysis, 2) in-depth interview, and 3) content analysis. According to findings from the studies, design guidelines for mobile web were finally established.

Keywords: Mobile, web, design, design guideline, smart phone.

1 Introduction

Data explosion is defined that the amount of data transferred among people will go much higher year after year so that it will explode. Cisco [1] predicted in their report that global mobile data traffic will “double every year through 2014, increasing 39 times between 2009 and 2014” reaching 3.6 exabytes per month by 2014. No one can doubt that smart mobile devices trigger this explosion.

Not only on data explosion but also on real life of mobile users, rapid evolution into smart devices has affected seriously and radically. It changes people’s attitude and behavior toward web as well. More people have their smart devices, more they access web sites via those devices. Does it make any difference between access via PC and via mobile to web users? What are the problems that users confront as they use mobile web and how can we solve those problems?

1.1 Mobile Web Design

As most of mobile users were using internet via featured phones which had been built on relatively primitive operating systems by individual manufacture, they experienced problems which hindered their immersive experience of using mobile web: small screen size, abstract input devices (e.g., 12-keypad), throughput of mobile network, and limited interoperability between web and mobile web (in Korea, they had to use different mobile web, Wireless Markup Language (WML) and Wireless Application Protocol (WAP), which varied according to service provider and did not let them use generic full-sized web.)

Smart mobile devices recently introduced to Korean mobile users (e.g., Apple's iPhone, HTC's Desire, and Samsung's Galaxy S etc.) seem to have been removing these barriers: they have big screen which is moderate enough to maintain mobility and haptic interfaces with touch screens, support broadband network (3G and Wi-Fi as well), and do fully support not only mobile web but also full-sized web. (Although iPhone does not support Adobe flash and Microsoft Active-X so that some features of web sites do not work, user experience of web surfing via iPhone has great advantages compared to that via featured phone.)

However, enjoying full-sized web sites via mobile phones is still a problem to some of mobile users. Nielsen [8] suggested in his column that "website use on mobile devices got very low scores, especially when users accessed "full" sites that weren't designed for mobile." He explored on four main usability hurdles: small screens, awkward input, download delays, and mis-designed sites. Although in order to solve these problems many web sites providers are establishing mobile web adjusted to mobile screen size, network speed, and touch interfaces, it is hard to find specific guidelines or disciplines for mobile web, which is accessible via smart phones.

Even a decade before Nielsen, Jones et al. [4] showed an interesting result regarding the relationship between screen size and task completion rates of use of web sites. "The large screen group answered twice as many questions correctly than the small screen group." Furthermore effectiveness of navigation on small screen was much lower than that on large screen.

Not only for users but also for designers mobile web is a challenge. Jones et al. [9] explained that "web designers are challenged even further by moving from the large screens and familiar input devices of the desktop computer, to the small, pocket-sized screens and limited interaction techniques of mobile devices."

It is true that many researches and development have been done for improvement of usability and design of *full-sized* web. It is also true that improvement of *mobile* web could be rarely found [7]. This study poses research questions on mobile web and its usability regarding design.

2 Research Questions

In the context of mobile user experience mentioned above, KT, the biggest telecommunication company in Korea, faced serious demands from users who had complained their unhappy experience on surfing full-sized web sites via smart phones and from many content providers who had offered mobile sites fit to mobile browser provided by KT according to existing guidelines for developers and designers.

The purpose of this study is to revise pre-existing guidelines (titled "Design and Development Guidelines for Mobile Web Sites via KT Mobile Browser") and expand its usage with more general purpose according to recent demands of great user experience of web surfing via mobile handsets.

Research questions are as below.

- What are the problems that users confront as they use mobile web?
- What are the design patterns of existing mobile web sites and what could be the recommended pattern among them?
- What are the principles for designing mobile web?

In order to explore these questions, three different studies have been performed: 1) task analysis, 2) in-depth interview, and 3) content analysis.

3 Study 1

3.1 Methods

First study, a task analysis was designed to find out the problems which users experienced during their use of mobile web. Participants were asked to use mobile web and observed when and how often they made errors. Within-subject design was applied to the study and tasks were counterbalanced.

Participants. Eight participants were recruited for the study followed by three different categories (gender, occupation, and experience of mobile internet) because those variables were supposed to be controlled. The participants are as follow: 4 females and 4 males, 4 college students and 4 employees, and 4 lay users and 4 experienced users.

Stimulu. The participants were asked to use two different mobile devices: LG's KU9000 and Apple's iPhone3GS (Fig. 1). Each device has its own browser, former KT Unified Network (KUN) browser and latter Safari. They were asked to use KT's mobile web portal SHOW (<http://m.show.co.kr>) on both devices and sites.



Fig. 1. Devices (LG KU9000 & Apple iPhone3GS) and web sites (m.SHOW.com)

Usability. In order to understand where and when participants experience difficulties or errors while performing tasks on a web site - because "it is critical to improving the design of a site" [9] - they were asked to perform four tasks as follow. Main missions of these tasks were information seeking, communication, and transaction which were major mobile web activity themes identified by Cui & Roto [2].

1. Please browse news services and read several articles. You may use search function.
2. Please browse music services and hear several sample clips. You may download or send ringtones.
3. Please check out today's weather.
4. Please check out newly released films.

During their task solving, thinking-aloud and video record (Fig. 2.) were performed for better observation on their behavior (see Kjeldskov et al.'s study [6] for review of task solving and thinking-aloud method).



Fig. 2. Screen shots captured from video clips of participants' task-solving session

Procedure. Entering the laboratory, participants were given brief introduction about the research and then given ten minutes for making familiar with stimulus devices. Facilitator told them to perform four tasks described on prior Usability section one by one and thinking-aloud as well. He was not to guide them how to perform tasks successfully. The whole sessions were video-recorded digitally for analysis of patterns of errors and difficulties which they experienced. After task-solving session, an in-depth interview was followed (this is discussed on study 2 section.), thanked with reward of fifty dollar cash, and dismissed.

Results. By analyzing video clips and participant's comment of thinking-aloud, two main problems of usability of mobile web were revealed, 1) interaction, and 2) navigation error. Mostly they experienced difficulties as they interacted with touch interface because the component of graphic user interface (e.g., buttons, icons, and other text-hyperlinks) was too small to touch. Especially lay users performed this touch interaction error ($M=4.5$) more than experienced users did ($M=2.5$). They also confronted errors as they were navigating (or browsing) both within a page (scrolling up & down) and through various pages (before & after pages and up & down depth navigation). Lay users experienced difficulties by performing errors ($M=3$) more than experienced users did ($M=1.5$).

According to analysis of participants' behavior, most of them were using only one finger to interact with mobile devices and web sites. Especially female participants experience difficulties as they interact with one finger due to their relatively long fingernails. Based on "almighty one finger [5]," the participants reported during their thinking-aloud session that scrolling did not matter as they were using a browser modified with touch interface though it was one of the biggest problems of featured phone and its browser.

In sum, the size of objects which were displayed on small screen and supposed to be touched with one finger affected negatively on the usability of mobile web.

4 Study 2

4.1 Methods

Second study followed by the first study was performed in order to get some valuable qualitative insights to enhance design guidelines for mobile web. A semi-structured interview was applied to each of eight participants who had been participated to study 1.

Procedure. After they had performed the first study, task-solving session, they were given a pencil & paper based questionnaire sheet. They were asked to fill in basic demographic information and four evaluation questions, which asked to evaluate each of four tasks (e.g., “what made you difficult to check out today’s weather?”). Then interviewer interviewed participants based on their answers.

Results. Most of interviewees complained about complexity of web sites. They did not like web sites crowded with too many texts and too many objects to be touched. They blamed poor usability of text input on small screen with QWERTY-based-on-screen-touch keyboard. They wanted simple and big web pages and light depth of structure though they consequently elicited long down scrolling (Table 1.). In sum, participants did not like rich experience browsing web but simple experience on mobile web.

Table 1. Evaluation on experience of mobile web

Evaluation	Lay users	Experienced users
Overall	• Too complicated. • Too many texts. • Hard to figure out what the content is.	• Too small icons and buttons. • I want simple!
Web surfing	• Want simple and big. • Want one glance for one page. • Want less text. • Too many depths.	• Headlines are enough for main page. • Simple and big beats scrolling.
Comparison to keypad	• Hard to zoom in and out. • Text input is annoying.	• Annoying text input.

5 Study 3

5.1 Method

In order to analyze design patterns of existing mobile web sites, 33 mobile web sites were categorized according to their design layout as a content analysis. In order to elicit optimum size of GUI component grid system prototyping was performed.

Design pattern. Screen shots captured from representative pages of web sites were printed out and categorized according to their page layout and design by two design experts. (Fig. 3.)

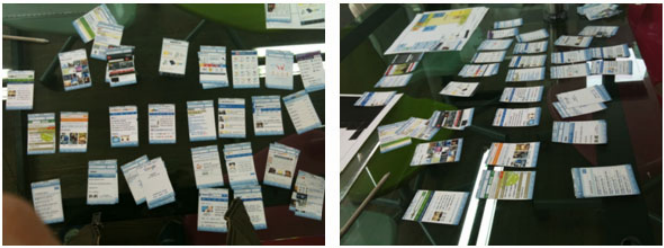


Fig. 3. Analyzing design pattern of existing mobile web sites

Grid system prototyping. Grid patterns of 33 mobile websites were printed on vinyl pad (Fig. 4. (a)) in order to investigate cumulative trace of all of grid layouts. The purpose of this examination is to analyze efficiency of space according to page design and grid system and to find out proper size of GUI component. Special application which could show and save cumulative traces of touch interaction was used during the analysis (Fig.4. (c)). Two design experts tested followed by this process.

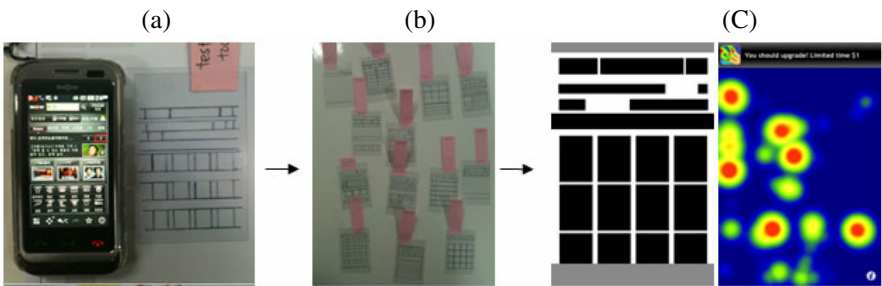


Fig. 4. Process of grid system analysis

5.2 Results

Analysis of design pattern elicited five types of standard design layout, 1) mixed type, 2) icon type, 3) image type, 4) text type, and 5) search type. (Fig. 5.) Optimum size of component which did not go over the size of each trace of touch interaction was elicited as 4.5mm (width) X 6.5mm (height) (Fig. 6.).

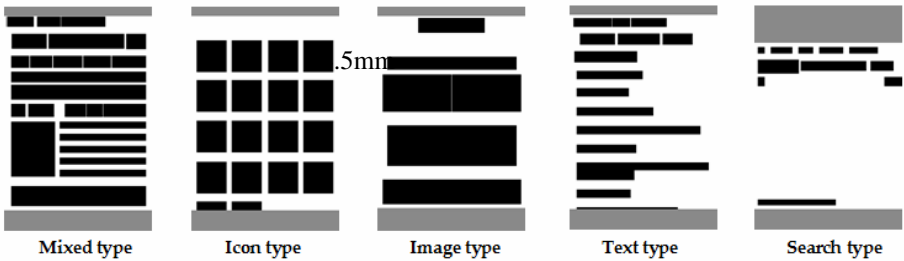


Fig. 5. Five types of design pattern of mobile web

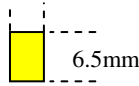


Fig. 6. Optimum size of touchable GUI component (actual size on MS Word)

6 Discussion and Application

Small screen of mobile device and unoptimized web sites distract users as they surf on web sites via mobile devices. In the study mobile web users performed errors as they interact with web sites due to small GUI components, complex layout and design of web pages, and complicated structure of web sites and annoyed poor text input interface. Findings of current study suggest that optimized mobile web site would be a must for service provider. However, “while there has been much successful work in developing rules to guide the design and implementation of interfaces for desktop machines and their applications, the design of mobile device interfaces is still relatively unexplored and unproven.”[3]

Current study was executed in order to revise existing guidelines (titled “Design and Development Guidelines for Mobile Web Sites via KT Mobile Browser”) and expand its usage with more general purpose according to recent demands of great user experience of web surfing via mobile handsets. As an application, newly revised guidelines were developed. The design guidelines (Korean version) are now available for downloading from KT developers sites. It is the first design guidelines for mobile web sites in Korea. Its main contents are as below.

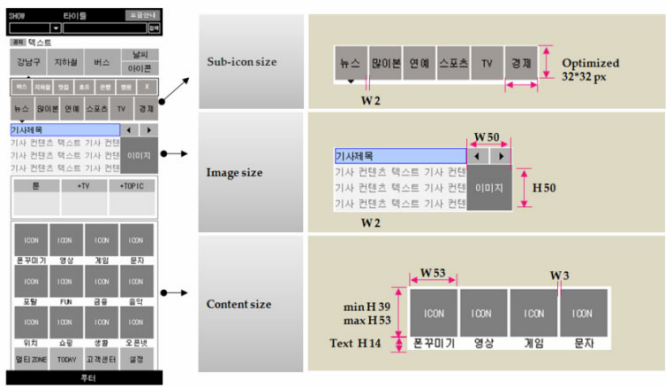


Fig. 7. Layout guideline (p.21)

1. Recommended layout guideline (Fig. 7)
Basic guidelines for layout are identified in the revised guidelines. In order to meet user’s needs of immediate information-seeking, search box should be on top of each page. Layout design is in the full range of freedom for content designer and developer other than pixel size of each component of content (e.g., main and sub icon, image, and text) in order to guarantee errorless touch interaction.

2. Five types of sample pages according to recommended layout (Fig. 8)

In order to help designers to design web pages more rapidly, the revised guidelines conveyed five types of sample pages of representative web sites: icon, image, text, search, and mixed type. Sample codes are also appeared in appendix section.

3. Library of GUI components (Fig. 9)

Recommended GUI components are delivered with guideline document as GUI library. They are to be used frequently or mandatorily, e.g., button of search, price, more, before, next, numeric, log-in, download, help, and input box.

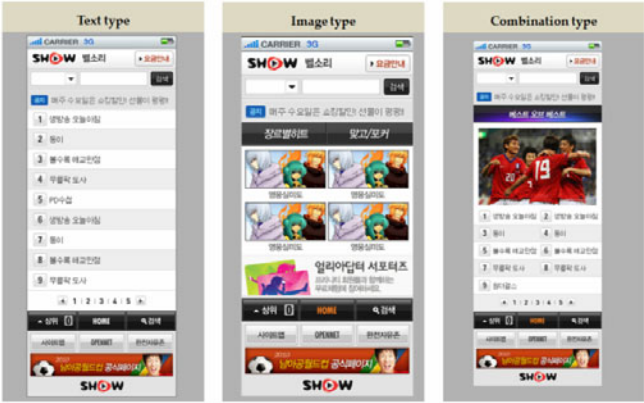


Fig. 8. Sample pages in regard of type of layout (p.23)

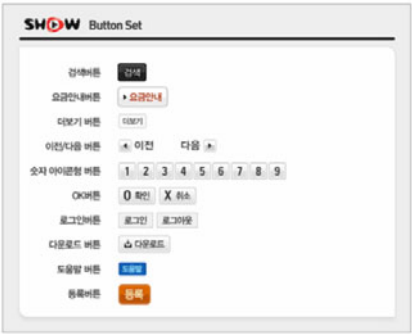


Fig. 9. Library of GUI components

7 Limitations

Although main purpose of the study was not a quantitative investigation, more sample participants would elicit more solid and specific direction for establishing design guidelines. Iterative design process (e.g., prototyping - user test - redesign process) would also benefit better design output of guidelines.

Above all, common problem of this kind of process of guideline and standardization is to be a mandatory. In the previous stage of mobile web, content provider should pass a test by operators because they use operator's browser and pricing protocol. However, in this smart mobile web stage, they do not need to follow operator's guideline mandatorily.

Mobile web services are supposed to be an alternative or ultimate future of recent mobile application services. In order to offer great experience to mobile users during their use of mobile web, every designer and developer should keep in mind that mobile and PC web are different.

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