A Study on the Mobile Web Generating using Element of User Experience

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Abstract—As mobile service's subscriber is increasing; mobile contents services are getting more and more variables. So, mobile contents development needs not only contents design but also guideline for just mobile. And when mobile contents are developed, it is important to pass the limit and restriction of the mobile. The restrictions of mobile are small browser and screen size, limited download size and uncomfortable navigation. So each contents of mobile guideline will be presented for user's usability, easy of development and consistency of rule. This paper will be proposed methodology which is each contents of mobile guideline. Mobile web will be developed by mobile guideline which I proposed.

Keywords—Guideline, interface, mobile, mobile computing, user experience.

I. INTRODUCTION

AS the number of subscribers to mobile content services has increased steadily, the content of such services has become growingly complicated and diversified. Therefore, it is required to go beyond producing simply "good-looking" content, and seek to overcome the limits of mobile services to deliver the content in a layout truly befitting such services.

Due to enormous costs in the early stages of mobile content production, many Internet sites have yet to provide mobile content although they have already identified the need for such content. To overcome these limits of mobile service and provide ease of production, uniform rules and user convenience, this study seeks to suggest consistent, content-specific guidelines for mobile content production. In this paper, it defines Small Device Guideline.

A wide variety of content has been provided in mobile Internet services. In reality, however, despite the growing need for Internet-based news content, mobile Internet services have failed to offer as rich content as websites have done.

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Therefore, Section 2 of this study reviews relevant research on how to produce mobile web content, and Section 3 identifies the need for translating news sites, where fast update and real-time news delivery are needed, into mobile sites and suggests guidelines for graphic design, Contents conversion, navigation design of news sites. In Section 4, methods for implementing mobile web pages—produced in accordance to the suggested guidelines—into templates will be suggested using Mobuilder and Mobile Contents Management System

(MCMS); Section 5 will draw a conclusion by running mobile web pages of news sites implemented via the methods suggested here. Section 6 summarizes results of this study and indicates that the mobile sites built this way should be further perfected through user tests.

II. RELEVANT STUDIES AND PROBLEMS

A. Relevant Studies

Several solutions have been proposed as to how to convert web-based content into mobile one. These solutions can be broadly divided into the following three methods:

The first is the re-designing method, which converts websites for mobile handsets and builds separate wireless (i.e. mobile) websites. This method reveals numerous problems, such as incompatibility between Internet and wireless sites and the waste of resources due to the need for building mobile websites separately from existing Internet ones. As websites and mobile websites have different support and display environments, however, this method makes it possible to create a mobile website befitting the new mobile environment.[1][2]

The second is the mobile-web 1:1 matching method, which simply reduces web documents in scale and converts them into forms of expression suitable for the mobile environment. In this case, users often go through the inconveniences of having to enlarge the screen or make long scrolls several times as content for bigger screens is shown as it is in a small-screen mobile environment with resolution lower than a computer's. This, however, is the most effective method for production of mobile content.[3][4] Furthermore, one can search for information right away in websites he is familiar with, but when navigating websites he is not used to, he often has to repeat searching and screen enlargement due to unfamiliar display.

To address such inconveniences and shortcomings, the third method of site-specific template operation has been introduced. It is similar to the re-designing method in that not only the formats but also the structures of content are adequately transformed, but its main difference from the previous method is that it utilizes the content as it is by accessing databases.[2]

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This method provides users with easier access to mobile web services, as the content is transformed automatically once pages for a mobile website are created.

To apply the template operating method, this study aims at developing guidelines for content and mobile pages in order to come up with standardized pages for mobile websites.

The role of guidelines has been widely considered important from the very building of websites. As mobile services are going through an era of evolution similar to that of the web services so this paper will come up with guidelines for mobile services with those for the web as the basis. The web is a combination of software and simple hypertext aspects. More recently, the importance of software-centric aspects (i.e. functional aspects) has been increasingly underlined. In websites, users interact with web applications, that is, with various software elements such as bulletin board, chatting and searching. When these users put information into the system, they often use a variety of forms. Buttons are also used to take certain actions on the system. In this way, not only web users but also mobile service users utilize various forms and buttons to interact with the system. In arranging and utilizing these elements, developers need to take the graphic user interface (GUI) into account.[7]

B. Problems

Various studies have been conducted to effectively express web pages and guarantee user convenience in mobile services in a way different from websites. However, there have been two major challenges that need to be addressed, and this study seeks to address these issues.

Resolution Until only a few years ago, the resolution had been set at 640*480, for the majority of users had 15- or 17-inch monitors. As graphic cards develop further and larger computer monitors are introduced accordingly, however, a growing number of users have turned to 17- and 19-inch models. This has also led to an increase in resolution—the very basis for designing Internet sites—to 1024*786.

Mobile handsets have different browser sizes by type of device. Currently, the most widely used ones are those between 120*140 and 320*240. Inconveniences owing to small screens and the development and spread of DMB technologies have led to a continued increase in the size of screens. However, the small size of screens still remains an obstacle for further development of mobile web services.

Navigation As seen in Fig. 1, one browses a web page mainly by clicking hypertext links among documents. Simple and consistent icons, graphics or texts, and detailed navigation in site maps or on the screen, help users find information they want without wasting time. In mobile settings, however, more key inputs are needed even for the same tasks; it requires more cognitive resources than other devices for users to conduct tasks they want. On PCs, users can simply click with their mouse where they want on the screen. As no cell phones have provided mouse functions so far, however, mobile service users have to use four arrow keys to move to the spots they want. Unlike the net-structured navigation environment of the web,

mobile service only provides four direction-based navigation as seen in Fig. 2[6].

C. Graphic Design

Font What is most important for fonts are readability and legibility. For mobile services, fonts with enhanced readability should be developed as the browser screen is small, and the types of colors also need to be limited, since these colors are seen on LCD screens.

In mobile services, font sizes cannot be as diverse as in prints or the Internet; fonts sized between 8 and 10 points ensure the best readability. Information offered by news sites consists mostly of texts, and given that too large fonts offer lower readability in smaller LCD screens, only the very basic fonts should be utilized for these sites. To emphasize the content, or to make some part of it (e.g. titles) stand out from the rest, either bold fonts or only 1 point larger ones should be used. Readability can be enhanced by utilizing bold fonts for important information, larger ones for displaying the current status, and smaller ones for additional explanations.

The serif font shows the best readability for printed English texts, but things are quite the opposite for dot LCD screens. The English serif font may be used for links in web screens, but except for such exceptional cases, it is recommended to use the san serif font. Among Korean fonts, gothic and Gulim provides better readability than Myungjo and Batang. The former two with excellent readability are fonts without any serif on their strokes. As news sites should provide objective information, it is recommended that basic fonts are used for mobile services.

Color Colors are divided into primary and secondary ones. Primary colors are widely used ones that set the tone for the entire site. As news sites are focused on accurate delivery of information, the background should be absolutely white, nothing else. To fully represent the credibility and objectivity of news content, blue and green should be used as main colors. As primary colors are widely used in the menu and upper part of the website, colors with saturation of 100 should be selected so that they can stand out. Also, the colors from the news sites' own logos should be utilized.

For secondary colors, high saturation, which may undermine the content's readability, should be avoided. Colors with under 50 saturation should be utilized to display grouping, lists of articles/postings and names of the menu. There are possibilities that titles and main texts of news articles might be confused with each other, so achromatic colors may be used to distinguish between them. Fig. 1 shows the color tables of primary and second colors.

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(a) Primary Color

(b) Secondary Color

Fig. 1 Primary color and secondary color of color table

Graphic Element Graphic elements in design guidelines include illustration, bullet, button and graphic images. For news sites, however, graphic images are avoided as best as possible, as objectivity, clarity and credibility should be enhanced at these sites. When graphic images such as buttons and icons are too complicated and showy, the very content being provided might be overshadowed. Only small and simple bullet (using 2-5 pixels) should be used so that readers' concentration on news articles will not be compromised. News sites utilize text buttons in the form of direct text links to text-based content.

D. Navigation Design

The Structure and Positioning of the Menu By analyzing what sections were preferred in overall sites, the menus were divided into fixed menus and flexible menus, which may vary depending on specialized content and services provided by each newspapers. Table I shows the orders of menus provided by Korea's major newspaper sites; their rankings were expressed as numbers. The order of menus in flow charts offered by the newspaper sites was defined in accordance with the order of importance. To formulate the guideline for menus, it is necessary to define the order and importance of the menus for individual sites using a single, shared standard of importance. In an effort to identify the importance of every menu, we defined the order of newspapers as a1-a10 and menus as m1-m13, and we used the following equation to figure out the importance of menus:

$$I_m = \frac{1}{N} \sum_{a=1}^{N} a_n$$

TABLE I
CONDITIONS FOR SELECTING FIXED AND FLEXIBLE MENUS OF THE GUIDELINE

a1-a10 / m1-m13		Overall News	Politics	Economic	Social	National	Editorial	Science	Culture	Sports	People	Entertainment	etc
1	Han	1	2	4	3	5	9	8	6	7	12	–	–
2	Donga	1	2	3	5	4	7	6	11	9	8	10	–
3	Josun	1	3	2	4	5	7	–	6	8	–	9	–
4	Joins	1	3	2	4	5	7	6	–	9	–	10	–
5	Seoul	9	2	3	4	6	5	–	8	7	–	–	1
6	Kyunghang	–	2	3	4	5	1	9	7	6	8	–	11
7	HanKuk	1	–	2	3	–	–	–	5	–	6	–	4
8	Hankung	–	–	2	–	3	5	–	6	4	–	–	1
9	Junja	1	–	2	–	–	5	3	–	5	–	–	4
10	Maekyung	1	3	–	4	–	7	–	6	5	–	–	2
Site Menu Order $(I_1 - I_{10})$		2.00	2.43	2.56	3.88	4.71	5.89	6.40	6.88	6.88	6.80	7.25	3.83

$I_n<6$ $I_n>6$
$a_n>5$ $a_n<5$
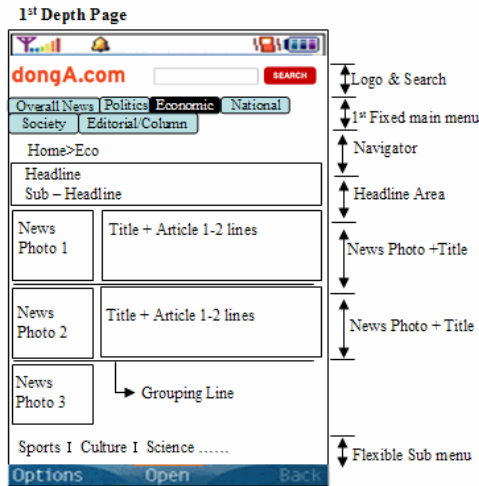
Based on the equation, when the value is In<6 upon an>5, most sites define the menu as the most important one, and choose it as a fixed menu; when In>6, they designate it as a flexible menu. The menus at an<5 are not stipulated on the mobile web guideline but are defined as those that may be replaced when users want. On this basis, the following menus were selected:

(a) fixed menus:
  - Overall news   - Politics
  - Economic   - National
  - Society   - Editorial/Column

(b) flexible menus that can be deleted, modified or added:
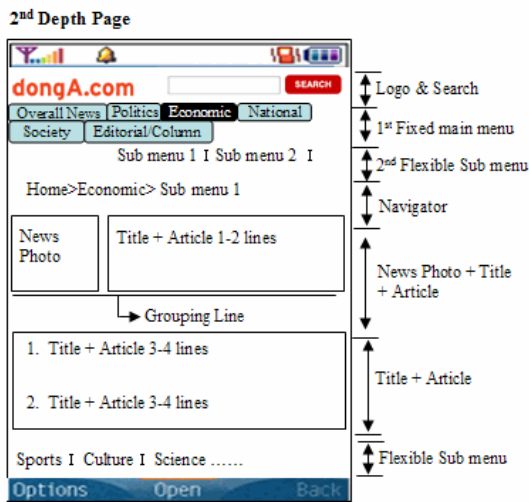 - Sports   - Science   - Culture

On Position of the Menu, fixed menus are placed at the top of the screen to facilitate navigation on the 1st and 2nd level of depths; flexible menus are put at the bottom of the screen so that users can easily select any of the options if needed.

Page Layout by depth Rather than displaying their main menus in the form of graphic images, news sites show the entire news articles first so that the headline news articles can be seen in the very first page. For news articles posted on the first page, their images and headlines are displayed together to provide users with the information more easily. In deeper depths, the texts of news articles alone are provided so that users can recognize the depth of the pages they are navigating.

Navigation By properly mixing sequence and hierarchy structures, it should be made sure that the number of navigation depths are no more than three, and that a navigator is provided for users to identify where they are. To keep the number of navigation depths at or below three, this paper defines a guide for Page 3 as in shown Fig. 2.

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(a) Design of the main page for a news site

(b) Design of Sub-Main Screens for Certain Directories

(c) Design of article pages for reading the content of the articles

Fig. 2 Design of screens based on the depth of news sites, using the methodology for the guideline

In Fig. 2, the screen was designed on the basis of the guideline defined above. In the first design screen, a, headlines were designed together with their images and corresponding texts so that users can easily see they are in the main page. The second screen, b, shows a page that can be seen when one of the content objects on the 1st-depth screen is clicked. Compared to the main page, this screen has fewer images and consists of more headline news articles and titles. The last screen, c, presents the content of a news article that the user clicks to read. It was arranged that the photo image is placed first and then followed by the title and content of the news article. We also suggest that a navigator should be added to each and every one of the pages to prevent users from getting lost in the sites wherever they are.

E. Content Conversion

An experiment was conducted, as shown in Fig. 4, to analyze visual responses to certain points on the Internet browser. The experiment demonstrated that the initial glance rate (the proportion of glances made by users) was 73% for a point in the left and 27% for one in the right. For points at the top and at the bottom, the rate was 69% and 23%, respectively. When two points were picked diagonally regardless of left and right, one at the top showed a considerably higher glance rate than the other at the bottom [9].
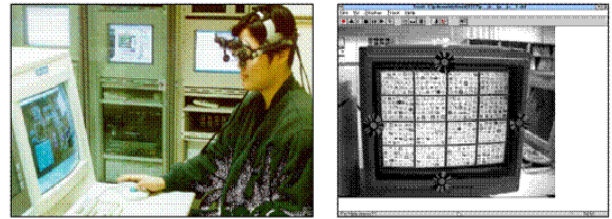

Fig. 3 Eye-tracking system

All these patterns show that a clockwise composition of a website (starting from the top left and proceeding to the right and then to the bottom) best befits the way humans instinctively move their eyes when looking at the browser. The second most suitable composition is one starting from the top center and then proceeding to the left and then clockwise.[9]

As users move their eyes from the top left to the bottom left while browsing websites, news sites tend to set the basic areas to the menu areas at the top, and place headline news below the basic areas, main news at the center, and other news in the bottom left and in the bottom right in descending order of their click rate (i.e. importance). Therefore, this kind of page navigation should be provided when producing mobile websites, too.
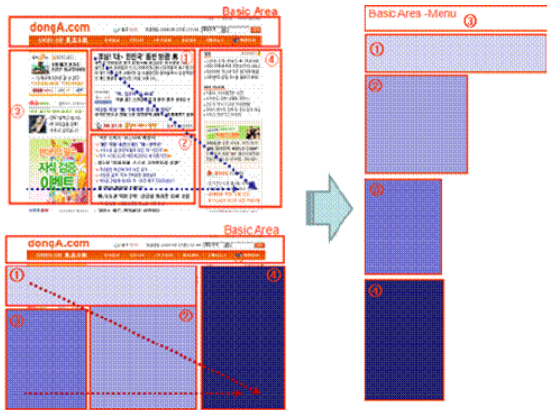
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Fig. 4 Sequences of content provision in news sites based on users' eye movements

III. MOBILE EDITOR FOR IMPLEMENTATION OF MOBILE WEB CONTENT

Based on the methodology for the guideline for news mobile sites, we utilized self-developed editor Mobuilder which is used for implementation of mobile sites. MCMS is a program for creating templates and interfacing databases, and generator Mobile Gate.
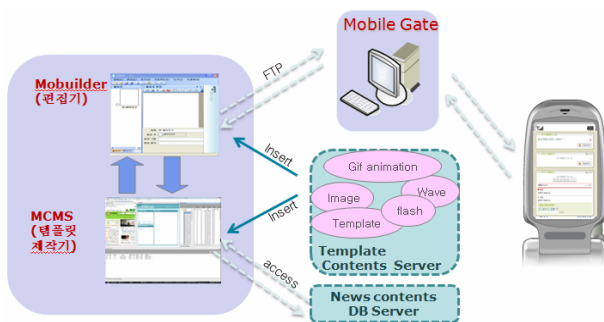

Fig. 5 Mobile web authoring process

A. Mobilder

We had developed Mobuilder, a program for generating and editing wireless web pages. This program uses the WISIWYG method enabling visual editing of pages (e.g. drag and drop, copy and paste). It makes it possible to bring objects from PC web pages and insert them into wireless web pages, and to generate new objects suitable for wireless web pages. With a single operation, users can generate content supporting all wireless web pages and handsets, so they can easily author web pages by making simple modifications or inserting images and other raw data. As the authoring is done on the basis of PC web pages, it takes less time to produce mobile content. The authors of this paper produced a news mobile web page in accordance with the mobile guideline, suggested by Mobuilder, as shown in Fig. 5.

Fig. 6 A Screenshot of Mobuilder

B. MCMS (Mobile Contents Management System)

The news mobile web pages produced here should be interfaced with databases in Internet news sites, and be automatically converted for mobile sites. This was done by using dynamic Mobile web CMS (MCMS), a program for collection, generation and editing of content. Interfaced with Mobuilder, it transforms news mobile pages into templates; it not only manages each of the content warehouses but also modifies mobile pages automatically, when the content is edited, and provides views on the relations among the content. It is also possible to convert or edit existing websites into MCMS-based mobile websites. As real-time updates can be done by simultaneously interfacing the mobile web with the Internet, production, modification and operation of mobile websites have become much easier. Furthermore, an independent .NET-based technological environment is supported to easily author mobile sites and thereby minimize operation costs and customizing work.

IV. EXAMPLES OF IMPLEMENTATION AND OPERATION

Based on the news mobile guideline suggested here, the design page of Hankyoreh Newspaper's mobile site was designed and produced. The site page guide was created on the basis of three types of pages: main, sub-main and article pages. Pages as shown in Figs. a-1, b-1 and c-1 were actually generated, and both their production and editing were conducted using Mobuilder. When mobile web production and editing are completed, the results should be saved in DIDL format. Each of the pages saved in the DIDL format constitutes a single DIDL file, so a total of three DIDL files, a project file (.mob) and a CB folder (contentbase) were generated and saved in the project folder.[15]

To transform the developed wireless web pages into templates and provide them for users, it is necessary to convert the DIDL files using the "template manager" of MCMS. After template transformation and interfacing of databases in newspaper websites and mobile templates, DIDL files are uploaded via Mobuilder's ftp view to the "mobile gate" server for wireless web service. The uploading of these mobile page DIDL files rounds up all the preparations for news site service. The files will be implemented in mobile services as portrayed in Figs. b-1, b-2 and b-3.

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Figs. a-1 and b-1 implement the 1st depth. As the main page of the mobile web, this page enumerates the headlines of news articles and the photos for the articles together, so users can immediately notice that it is the main page. Figs. a-2 and b-2 show the sub-main page representing the 2nd depth. This page includes mobile implementation and the guideline for sub-main pages of certain directories. The 3rd depth was developed as shown n Figs. a-3 and b-3, and this page is where users can actually read the content of news articles by picking a news article page in any directory. By indicating the relation between the list of news articles and the images, it enables users to easily identify where they are in the site.

1ST DEPTH: MAIN PAGE

(A-1) (B-2)

2ND DEPTH: SUB-MAIN PAGE

(A-2) (B-2)

3RD DEPTH: DETAIL ARTICLE PAGE

A-3 B-3

Fig. 7 Development of the template by Guideline (A) Development of the Guideline for the Hankyoreh newspaper template (B) Implementation of templates generated in accordance with the guideline on the mobile web

V. CONCLUSION AND LIMITATIONS

Directions for development and trends of mobile services represent the very essence of how the web has evolved. Therefore, evolution of mobile and of web services has shared many things in common. In implementing mobile sites, not only the basic principle of the web but also the progressive aspect of portability should be taken into account. So far, Web services have adopted well-established and formulated guidelines, and websites have been developed accordingly in place. For mobile services, on the other hand, it is urgently needed to identify and analyze their limited characteristics, and to suggest a guideline fully reflecting these characteristics and overcoming limits of mobile services.

Therefore, this study identified the characteristics and limits of mobile services and, on the basis of research and theories on web guidelines, came up with a guideline for mobile news sites. In accordance with the methodology suggested here, we formulated six rules for the guideline, including those on fonts, graphic elements, colors, content production methodology and menu structure.

Expected benefits are as follows: First, news content suitable for mobile services can be offered to users. Second, news sites can be produced fast and efficiently. Third, after the site development, modification or generation of detailed tasks can be done easily by utilizing the menu structure, color structure, font selection, screen composition based on content arrangement, and image templates within the sites. The guideline also makes it possible to develop the sites cost-effectively. Even when developers or administrators are replaced, the sites can be produced in a way consistent with the initially planned structure. Fast updates of news, the most essential task for news sites, can also be performed effectively. To realize the guideline-based implementation in a more specific manner, mobile news sites were implemented using Mobuilder and MCMS. Given this study suggested a specific mobile production guideline only for mobile news sites, it is necessary for future research to formulate detailed guidelines tailored to different types of content and sites, and to conduct user tests on mobile sites that are developed using Mobuilder, so as to further enhance their level of perfection.

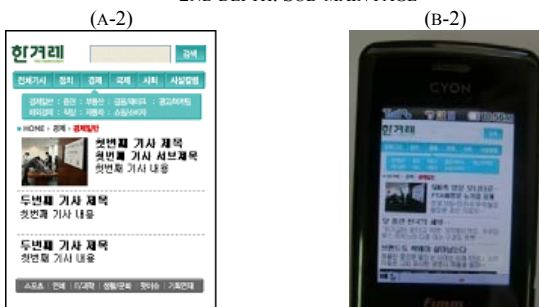### REFERENCES

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