Perception of Narrow Web Pages
on a Mobile Phone

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Abstract

Viewing web pages on a small screen is a topical issue on mobile phones. PDA devices have provided access to the full web for a while, but recently web browsers have also become available for mobile phones. We conducted a study on how ordinary users perceive familiar web pages on the 176x208-pixel color display of a mobile phone. We used the commercial mobile browser that reformats web pages in a tall and narrow layout, using a server side proxy. We found that the users were delighted to have the web on a mobile phone and saw that narrow layout on a mobile phone is a surprisingly good way to view web pages. We also found some areas of improvement, such as providing the interesting content before the information that is often ignored on a large screen.

Keywords: Internet, Browser usability, Mobile Phones, Narrow Layout

1. Introduction

Because it is difficult to view full web pages on the small screen of a mobile device, the WAP (Wireless Application Protocol) system was developed to provide a mobile Internet, a web optimized for mobile devices. WAP 1.x sites are isolated from the fixed World Wide Web: These sites are not viewable through desktop browsers, and fixed www sites cannot be accessed with WAP devices. WAP 2.0 content with XHTML Mobile Profile as its standard language now enables WAP sites to be viewed through ordinary web browsers. However, pure WAP 2.0 browsers are still unable to view all web pages because of the limitations of the Mobile Profile of XHTML.

Many web viewing solutions presented in the literature are targeted to monochrome displays and to very limited network bandwidths [Kaasinen et al (2000), Buyukkokten (2000, 2001), Björk et al (1999), Jones et al (1999b)]. In year 2003, most new mobile phone models are equipped with color displays and General Packet Radio Service (GPRS) connections. We assume that most users accessing the web through their mobile phone will do it over GPRS or quicker connections and with color displays. Although speed and colors improve the web

viewing experience a lot, the display-size size limitation will remain an issue until mass produced phones undergo a change in their form factors, e.g., a foldable display. It is possible to send graphical web pages to the user, but there has to be a smart way to view the content on a small screen.

When reviewing the literature, we were not able to discover any research available on the narrow layout method for web pages, although most mobile browsers currently available use this method. We wanted to find out how users understand and perceive familiar web pages reformatted as narrow and long ones onto a small display. Do the users feel they are using the familiar page, and can they imagine using a similar method to access the web through their mobile device?

Figure 1:
Finnish railways site on
WebViewer browser

In this paper, by the word *web* we mean the fixed world wide web. There is also the *mobile Internet*, e.g. WAP or i-mode, that is specifically designed for mobile devices. Viewing WAP pages on mobile phones is a different research area, because the WAP pages are designed in a very different way from the fixed web. We have investigated WAP page design for instance in [Kaikkonen, Roto (2003)], but this paper is not about WAP.

2. Approaches to Viewing Web Pages on Small Displays

We have investigated three major types of web viewing methods in the literature: content filtering, original layout, and relayout of the page.

The filtering methods minimize the amount of information on the page and aim at sending only the relevant piece of information to the terminal. Filtering methods are divided into ones that are based on the structure of the HTML page [Kaasinen et al (2000), Buyukkokten et al (2000, 2001), Björk et al (1999)], and ones that filter the content based on user's preferences [Bickmore & Schilit (1999), Anderson et al (2001)]. The main drawback of all filtering methods is that it is very hard to find the relevant content from a page without specific meta data in the HTML code.

There are few studies [Jones et al (1999a)] available on viewing web pages with the original PC layout on a small display. We have found no studies on pure web page relayout methods, where the system shows as much of the page content on one page as possible, but adapted into a format viewable through a small screen. Our paper seems to be the first one to fill this gap.

In spite of the ambitious web viewing solutions in the scientific literature, in commercial products we still see very simple solutions on mobile phones and PDAs. The pages are either shown in their original layout, or they are reformatted to narrow layout.

Because our focus is on mobile phones, let us first describe the phones offering the possibility to view web pages, and then the mobile web browsers available for these phones.

The phone we used in the test, Nokia 7650 (Figure 2), follows the Nokia Series 60 user interface style, which is currently the leading platform for smart phones. Phones built on Series 60 all have the same display resolution and input possibilities. There is no mouse or pen available, but a joystick or similar input device that allows 4-way movements and easy selections at the current point of focus. The contrast, color depth, and resolution are good enough to show the color images on web pages.

At the time of writing this paper, September 2003, there are four commercial mobile web browsers available for Nokia Series 60: Opera by Opera Inc., NetFront by Access Inc., WebViewer by Reqwireless Inc, and Doris by Anygraaf Inc. We conducted the tests early in the year 2003 when WebViewer was the only appropriate browser.

We do not know the exact relayout algorithms used by WebViewer, but by comparing the pages on PC and on WebViewer running on Nokia 7650 we can see a set of differences. The two-dimensional layout of many web pages is transformed to one-dimensional by taking the contents of table cells and showing them one after another (Figure 1). The images are scaled to fit the display width; the scaling percentage seems to be the same for most

Figure 2: Nokia 7650

images. White space, animations, and scripts are all ignored, so are all Cascading Style Sheet (CSS) definitions for such features as the background color, font face, and size. The interactive HTML components such as text fields and buttons look and feel different, and the link texts are always blue and underlined.

WebViewer provides two options for scrolling:

1. Because there is no pointing device, the focus must somehow move from one interactive component to the next. The joystick-down movement moves the focus to the next component and the view scrolls down as needed. If there are many links on one line the view does not scroll, only the focus moves to the next link. If there are no interactive components on the rest of the screen, joystick-down movement scrolls the view down half a screen.

2. By pushing the joystick to the right, the view jumps almost one screen down so that the bottommost line is shown at the top. The focus is on the first interactive component, if there is one.

There are two major limitations in WebViewer v2.0. First, it cannot show frames in a usable way, but offers only a list of frames and a possibility to view the frames one-by-one. Second, it is not possible to access secure web pages, e.g. those requiring login. On the other hand, the proxy solution makes the content download surprisingly quick, this is very important for a comfortable web browsing experience.

3. Perception Test

We carried out an exercise to test how users perceive familiar web pages on a small screen. We used a Nokia 7650 mobile phone (Figure 2) and a commercial mobile HTML browser, WebViewer by ReqWireless Inc. WebViewer uses the relayout method to view the pages: it reformats the web pages to a narrow and tall layout to avoid horizontal scrolling.

Because we see that the scrolling method has a big effect on web page perception, we wanted to use a real device to view the pages. The Nokia 7650 mobile phone provides a display of 176x208 resolution and 4096 colors, plus a 5-way joystick that allows vertical and horizontal moving and a Select function.

We used 11 participants for the test, which is an adequate number to find the most important usability problems of a product. We screened the participants to use the fixed web daily but

not necessarily to know the mobile Internet. The age of participants varied from 14 to 55 years, and out of the 11 participants, 6 were female.

Most users were Finnish, but two were from Singapore and one from the USA. The participants had no or little experience on the Nokia 7650, so we first let them practice using the phone.

The selected participants sent us beforehand 2-5 URLs to websites that they frequently use with a PC. We bookmarked 1-3 sites for each participant on the mobile phone, and accessed a total of 18 sites in the test. Because we studied web page perception, we wanted to have the users view sites whose structure they remembered and which they were motivated to use. Naming a single site or two would have helped us to compare the user comments and analyze specific layout solutions, but it would have been an artificial setting. Instead, we hoped to gather comments on many different kinds of web sites and get comments on different web page layouts.

Users were first asked to draw a sketch of the first page of the site. After this, we asked them to describe a typical task they execute on the site, and carry out that task with the mobile version of the site. Examples of the tasks:

- Find the timetable for the next train from Helsinki to Tampere (cities in Finland)
- Find information about mobile games
- Find a shipwreck by location or name

When opening the site, we inquired which element the user was searching for. During task execution, we encouraged the user to think aloud by asking questions as needed. After the user had performed the task, s/he was asked to compare the mobile site experience with the experiences on the PC site. If there was time left, we took the same steps with another favorite site of the participant.

Based on the findings from [Kaasinen et al (2000)] and some other studies, we had specific silent questions in mind during the task execution:

- How much irrelevant content there is at the top of the page? Does that irritate the user?
- Does the user feel there is too much scrolling? Does s/he find the way to scroll screenfuls?
- Does the user comment about the speed of download?
- How often does the user need to go back?
- Is the user using or missing a keyword search?

These topics were not necessarily discussed with the participants, but we found the answers to these questions by observing their behavior and by listening to their spontaneous comments.

3.1 Results
The users were able to execute the agreed task in 13 out of 18 cases. The reasons for not completing tasks successfully were related to the content of the site: animated content, frames, secure content, and an uninterpretable image map. In one case, the site just did not give us an answer to a query.

Because WebViewer could not show Flash animations, one site (www.eminem.com) could barely be viewed. The only content the user could see was the bottommost logo area, which did not help in executing the task. This kind of multimedia presentation will be a challenge for

mobile browsers, and for now, we believe that the best solution is to find and fetch a more accessible version of the site to the mobile device.

This version of WebViewer did not function well with frames. If there were frames on the starting page, the first view that the user saw was a list of frames (Figure 3). This was very surprising for the users, since most users do not know that some web pages are composed of areas called frames. Even if the

Figure 3. View to a page containing frames

meaning of the list of frames would be explained to the user, it would be impossible to guess which frame s/he should activate. In most cases, the name of the frames did not reveal the semantic contents of the frame. The user just selected one of the frame links and if that was not the right one, s/he got totally lost. The users had to give up a task 3 times because of the frames were so hard to use.

On 6 sites, users wanted to log in to the site in order to execute the task. WebViewer v2.0 cannot access the secure pages, however, so we had to quit or change the task. If the users were able to complete the agreed task, they were excited about the possibility to view web pages with this phone. Some users wanted to continue browsing even after completing the required task.

3.1.1 Effects of the relayout
It seemed to be easy for the users to understand that the page was squeezed to fit the display width. They easily found the way to scroll down by pushing the joystick down. It was much harder for them to understand the functionality of sideways movement of the joystick. Only 2 users used this sceenful-at-a-time scrolling feature during the short test session.

When the users started to use the site on the mobile phone, 10 users started to look for a hyperlink, because that was their first goal in the task execution. On a big screen, users find the familiar link by its place, so many users tried to find the layout groupings on the one-dimensional mobile page to find out which portion of the PC page they were now viewing. Some users did not seem to search for the page groupings, but were checking the possibly matching link names. The users who wanted to keep track of the content area mapping on the narrow page were complaining about missing separators between the areas.

The first goal of 3 participants was to type something into a text field, so they were searching for the field instead of a link. Because the rendering of text fields, and some other HTML components as well, was very different from the PC style, the users easily scrolled past the field (e.g. on Google page).

After executing the task on one site, the users were ask to rate perception-related aspects of the system, and to justify the score.

How hard it was to spot a link (or a text field) on the page, compared to the PC case?
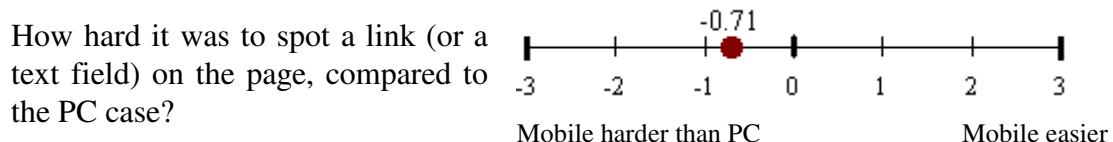
Reasons for the negative ratings included difficulties in getting the picture of the whole site, the fact that the pieces of information are not in the order of normal perceiving, and that HTML elements, such as text fields, look and feel different from a PC.

Three users spontaneously complained about extensive scrolling, and another two about the need to read through the irrelevant information at the beginning of the page. Because the old routines for site navigation could not be used here, one has to concentrate more in browsing the information.

3.1.2 Utility
After the whole test, the utility of mobile web usage was inquired:

Can you think of using some Web sites through this kind of a small screen?
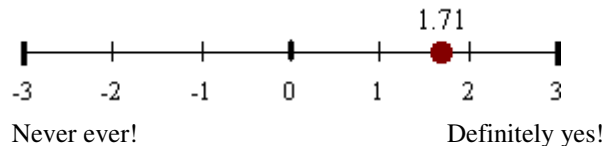
In spite of the usability problems found, users gave relatively positive ratings to the utility of viewing web pages through a mobile phone. They commented that they could imagine checking maps, timetables, addresses, opening hours, and email while traveling or commuting. The negative feedback included the need for learning to be able to use the system efficiently and again, the need for concentration to keep track of the current location on the page. One user even argued that he should check first the PC site to be able to estimate where the information appears on the narrow page.

We also asked users if they would use the mobile web in a different way from the PC web. It was hard for many users to answer this question, but some users expected increased use of search functions. They also commented that they would use this system only for specific information search, because the small screen and low bandwidth are limiting the browsing experience.

3.3 Discussion
During the first time use, users were impressed about the possibility to view their favorite web pages on a mobile phone. We did not test viewing of unfamiliar sites.

Our findings are supporting the findings of [Kaasinen et al (2000)]. Kaasinen et al did not, however, test viewing a web page as one tall page, and they filtered images off from the mobile pages. The device display, the input mechanisms, and connection bandwidth were also different in these studies: Kaasinen et al used a Nokia 7110 simulator on a PC, whereas we used a real Nokia 7650 and a GPRS connection.

Unlike Kaasinen et al, we encountered the biggest problems in frame presentation. Frames were not a problem in Kaasinen's study probably because their idea was to split the page onto cards anyway, whereas WebViewer normally provides the whole page at once. Another reason might be that they were luckier than we in finding pages with meaningful frame names.

3.3.1 Effects of the relayout
On familiar web pages on a PC display, users remember the position of the interesting link or information, focus their attention there and ignore the rest of the page content. When viewing the same content reformatted to fit the display width, the user needs to scroll through the content that comes before the interesting piece of information. This has several drawbacks, as described below.

The users cannot spot information by its location anymore. We expected this to cause a lot of trouble for the users. The users managed, however, to spot the needed components from the

narrow page by recognizing a familiar term or image. But if the look of the component was different from the PC look, it was hard for the user to spot it from the page. We can confirm the finding of [Kaasinen et al (2000)] that the users do not seem to suffer much from the relayout, as long as they are able to follow the familiar navigation path.

After selecting a link, the user feels confused because the first screenfuls of the new page may look exactly the same as those of the previous page. The first screenful of the page often contains logos and banners that do not change from page to page.

On one hand, the components on the page become equal, because the text size is the same for all texts, images are scaled within similar limits, and the user has to scroll also through those components that are normally ignored on a big display. On the other hand, the content on top of the page get the priority, because it is the content that the user will always notice. Meanwhile the user has to be really motivated to check the components at the end of the page.

On the PC, users can clearly see the division e.g. between the link list on the left and the content area in the middle. On this system, there was no separator between these areas, so it was hard to map the location on the narrow page to the PC page.

Row-by-row scrolling with narrow and tall pages would be very laborious, so a fast scrolling method is essential for this layout style. The scrolling technique must be truly intuitive and easy to find for the users, otherwise it may remain unused.

Scrolling through the page content was not an entirely bad experience during the first time use, since the users found new interesting content from the site now. But especially when there were big ads on the way to the target content, the users were irritated about the effort needed to scroll over the ads: "this is the last thing I want to see now". In long-term use, scrolling will be a bigger pain than in the first time use.

Images were scaled to fit the width of the display, but we did not see this affect the image interpretation much. In the few cases where there were small texts on large images, the user was not able to read the texts. In most cases, it was the lack of support for flash animations and scripts that made graphical content unusable.

4. Conclusions

We examined web page perception on a mobile phone with 11 participants. We used Nokia 7650 mobile phone with WebViewer browser, which reformats the pages to a narrow and tall layout to fit the width of the display. We found that it was easy for the participants to grasp the narrow format of pages on a small display, and they were enthusiastic about being able to view their favorite web pages through the system.

There were some usability issues with the narrow pages. The main problem with this relayout method was the order of content presentation on a small screen. On a big screen, the user's attention is mostly on the central part of the page and not at the very top. On a small screen, the topmost information on the page got the highest priority. Five users were confused by the fact that after selecting a link, the first screenful of the next page did not necessarily show the new information. The dynamic content was near the center of the page, and on a small screen, users had to scroll down quite a bit to see this data. If the relayout algorithm could show content in relevancy order, it would make the narrow pages much more usable.

Web page perception is closely related to the scrolling (and possibly zooming) method, since the user perceives a large page only by scrolling. The mobile browser needs to provide an obvious and efficient way to scroll the tall pages quickly. WebViewer offers one-screenful-

per-click scrolling by lateral joystick movement, which may be a decent scrolling method. Our test session was too short, however, for the users to get the idea of this feature, but they pushed the joystick sideways only when they wanted to move sideways.

The participants showed a green light for the idea of web viewing even on a 176x208-pixel screen. However, there is a need for even more usable web viewing methods for small screen devices. We will investigate methods giving more control for the user in viewing the different parts of the page.

Because large web pages will never be as usable as pages tailored for mobile use, we believe that content tailored specifically for mobile devices will be needed for services that are likely to be used with mobile devices. Web and WAP will co-exist, and they both will go strong.

Acknowledgment

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