

Search on Mobile Phones

Virpi Roto

Nokia Research Center,
P.O.Box 407, 00045 Nokia Group, Finland
+358504836631
virpi.roto@nokia.com

INTRODUCTION

Most people know keyword based search function from the Web. Ordinary people may have tested also file search in MS Windows, or text search in a word processor. In the future, most people will be familiar with search functions on their mobile device, too. The search functions on a mobile device may differ radically from the search functions on a PC, because some day, the mobile phone will provide us location-dependent search.

SEARCH THE MOBILE INTERNET

Currently, the search functions you execute with a mobile phone are searches from the mobile internet. Google provides an excellent search tool for the mobile internet, too. Also the sites available for mobile users may provide search within the site.

We conducted usability evaluations on two mobile internet sites, and investigated also how search function was received among the 30 international users. The hypothesis was that most users would not like to use search, since the effort of writing with the phone keypad might be too laborious. Search was, however, a very successful method of navigation, and many users saw it as the most comfortable way to find the needed piece of information. We want to note, however, that search is fine for more complicated cases, but the user should not need it for the most common cases like checking the weather forecast for tomorrow in the current place.

In the appendix "An Evaluation on Search in the Mobile Internet", we will describe the test procedure and the main results related to search function. More findings on this study are presented in [Kaikkonen & Roto].

LOCATION DEPENDENT SEARCH

Because mobile devices move with the users, new kind of search functions are possible with them. Many applications that check the location of a mobile phone are there, and can help the user to find e.g. the nearest gas station or hamburger restaurant (e.g. Finder WAP service by Sonera in Finland).

The Bluetooth technology in modern mobile phones enables phones to communicate with other Bluetooth devices nearby, within about 10 meters. This will be a revolutionary change for the mobile phone usage, since the chances to find and communicate with the people and items nearby will provide a totally new way of communication.

Whatever the technology behind the location based communication is, it will also affect the ways in which a search function is used. We see two new types of search coming:

1. Real-time search for nearby objects
2. Predefined search for objects the user may pass by

In case 1, realtime search for nearby objects, the typical use cases are e.g. restaurant or automated teller machine searches when the user is at a place which s/he does not know. In these cases, entering search criteria should be very easy, because it is likely that the user is on the street or in a car.

The other case we see very interesting, because it is a totally new way of searching. A typical use case could be finding the offers for the items on my shopping list. If the user needs to buy a specific item, e.g. a Nokia 7650 mobile phone, he enters this item on a shopping list placed in his mobile device. When he passes by a shop that offers this phone model, the user gets a notification with the price information.

Another use case for predefined search is more like a reminder: the user may carry a letter to be mailed, but he knows he may not remember to do it. He enters a predefined search for a letter box to his mobile device, so that when he will pass by one, he will be notified.

The case for adding items on a shopping list is not as time critical action as the others, and one cannot expect every shopping list item to be selectable from a list. In the other cases, however, the user is searching a point of service (restaurant, ATM, letter box), where the selection should be possible also without typing effort.

If the search criteria definition is too hard, these location dependent search actions may not become popular. However, if it will be easy to use these search functions, they will really have an effect on our every day life.

APPENDIX: AN EVALUATION ON SEARCH IN THE MOBILE INTERNET

Nokia Research Center conducted a comparative usability evaluation on two mobile internet sites:

1. A News site for information retrieval tasks
2. An Auction site for transaction tasks

The sites were specified and developed just for this evaluation. Only the parts needed to carry out the test tasks were implemented.

To be able to compare different navigation methods and to find the preferred user interfaces, the services were implemented in three different user interface styles (Table 1). All the user interfaces contained the same data, but the way the data was presented, navigation, and the usage of the elements varied in each user interface style. To avoid associations that would make one style better than other, we named the styles according to fruits.

 Banana “long content”	Long pages, flat hierarchy; Selection lists; Layout tables; Images
 Orange “slices”	Short pages, deep hierarchy; Multi-page forms; Choice for text input or value selection; Data tables; Small images
 Apple “for experts”	Keyword search prioritized; Accesskey shortcuts; Textual input; No images

Table 1: The user interface styles used for comparison

The structures of the 3 styles are presented in figures 1, 2 and 3. The number of users' steps for one test task, finding information about a basketball game, can also be seen in the figures.

METHOD

We conducted two test rounds. The first test was carried out with Nokia 6510 (Europe) and 6590 (U.S.A.) mobile phones and the second test with Nokia 7650, all running a prototype version of the Nokia mobile XHTML browser. The applications were used via GPRS connection as WAP services, and the implementation was pure XHTML Mobile Profile.

In the first test, the number of subjects was 20: 12 in Helsinki, Finland, and 8 in Boston, U.S.A. The subjects in Finland were from various European countries and from Japan. The subjects varied from active users of the current mobile Internet to ones that had never used it. All but one user knew, however, at least the principle of either WAP in Europe/USA or Japanese mobile Internet (i-mode, J-sky or EZ-web). In the second test with the Nokia 7650, the

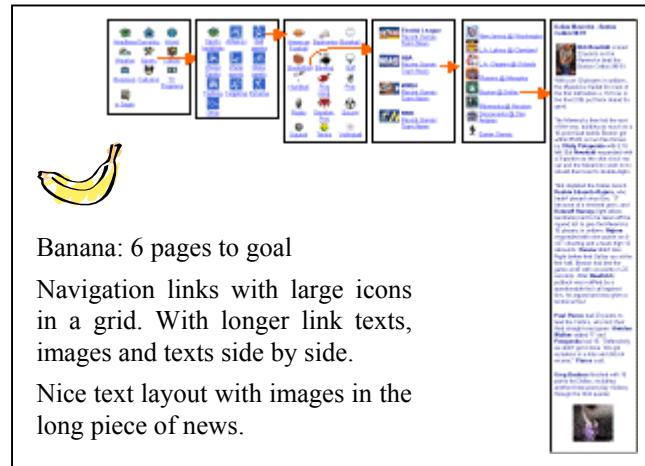


Figure 1: Banana style for finding sports news



Figure 2: Orange style for finding sports news

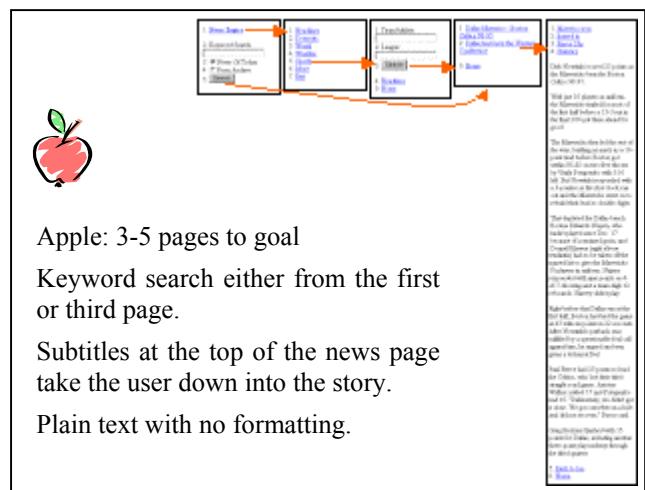


Figure 3: Apple style for finding sports news

number of test persons was 10. Eight users were Finnish, one was Romanian, and one Indian.

All subjects in both tests used a mobile phone daily and they knew how to type with a mobile phone keypad: they had inserted names to the phonebook of the phone or written text messages.

Users were asked to think aloud, and their comments were recorded together with the video image on a digital video camera. The testing order of the services and user interface styles was counterbalanced.

The tasks users were asked to perform in the News service were relatively complicated:

1. Finding the weather forecast for a specified location and a specified period
2. Finding information about the performance of one basketball player in a specified match

Tasks in the Auction service:

1. Deleting an offering from the list of own offerings
2. Modifying an offering on the list of own offerings

Each user performed each task three times, once per user interface style. They were allowed to use the time they needed to execute the task; there was no time limit. Most users performed all the tasks with all the user interface styles within 2 hours, but some users did not have the time to complete all the tasks.

After testing each service with a certain user interface style, users were asked to rate the user interface style on a scale of 1 to 5, 1 meaning very bad/difficult and 5 very good/easy.

The questions were:

1. Did you always know how to proceed?
2. How easy it was to locate/ recognize components?
3. How quickly did the system let you execute the task?
4. Did you like the visual outlook?

We made analysis of the times in specified tasks and user satisfaction ratings. We also performed a qualitative analysis of the user performance in test tasks.

RESULTS AND DISCUSSION

Task Execution Times

In the News service, the Orange user interface style with split pages was slower than the Banana and Apple styles. The difference was statistically very significant ($F_2=16.57$; $p<0.001$). The differences in Auction task times were not statistically significant.

1 st test	Banana News	Apple News	Orange News	Banana Auction	Apple Auction	Orange Auction
average (sec)	291	249	789	450	388	326
st. dev.	109	85	418	216	140	124

Table 3: Task execution times in the first test

There were not significant differences in performance times in the second test with a bigger phone, Nokia 7650.

2 nd test	Banana News	Apple News	Orange News	Banana Auction	Apple Auction	Orange Auction
average (sec)	377	225	341	409	381	394
st.dev	91	89	170	171	138	235

Table 4: Task execution times in the second test

Subjective ratings of the different user interface styles

In the first test, the Apple style with search function was the preferred user interface style. Most significant differences were in finding the way to proceed and in item locating, compared to the Orange News (Figure 4).

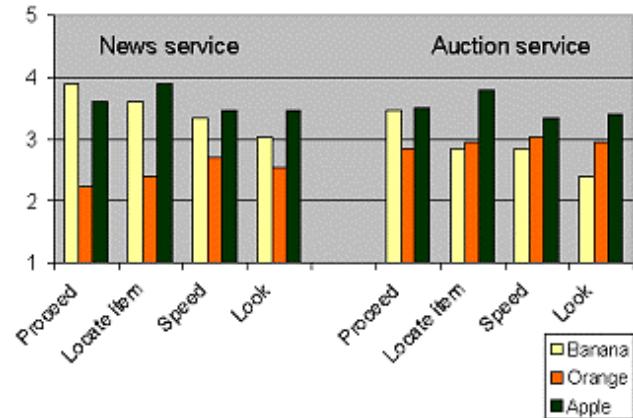


Figure 4: Subjective ratings of the styles (1st test)

In the second test, the phone display was bigger, and the Orange user interface was redesigned so that the too short pages were combined into longer ones. These changes made the Orange style more successful, and there were no statistically significant differences between the styles (Figure 5).

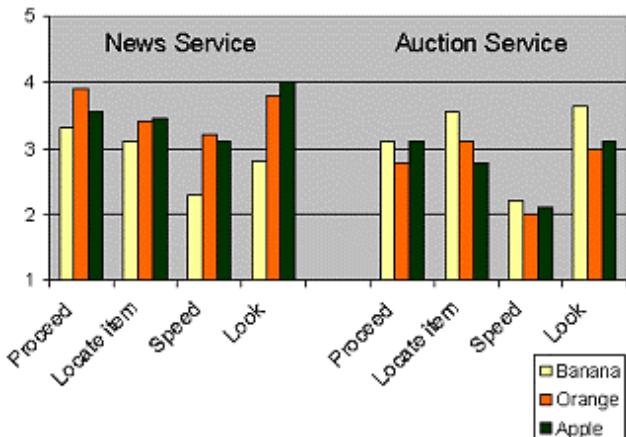


Figure 5: Subjective ratings of the styles (2nd test)

Discussion on the Search Related Results

We provided two methods for the users to find the target page from the News site: either follow hyperlinks or use keyword search. Our hypothesis was that users would prefer the hyperlinks over the keyword search, because it is relatively difficult to write text with a normal phone keypad. There also exists a WAP design rule "minimize the need for text entry in mobile services" [3].

In our test service, the system always provided two matches for a keyword search. That gave the impression of efficiency. In some cases users could alternatively make selections and go forward by selecting items with a radio button or check box.

Users were pleased in using the efficient Search function, and complained about the Banana style that did not offer such a tool. The way the Search function was provided affected its popularity a lot: if the keyword field was right on the page and not behind a link, users selected it surprisingly often.

Navigating in a list of items

When we asked the user to delete a named item from a list of offerings in the Auction service, the best interface provided the offerings on one compact list. When the interface required extensive scrolling to find the item, 21/30 of the participants used keyword search to locate the named offering.

For the price halving task, keyword search was not possible. We provided sorting option for the users in the Apple style, but only 7/30 participants realized that they could use sorting. We did not find a working method to search for items with a specific set of parameter values on a small screen, because the data table interface is hard to perceive through a keyhole view.

CONCLUSIONS

The keyword search was surprisingly popular in our study. The users seemed to cleverly estimate the navigation effort through links versus via search, and when they expected a long navigation path, they preferred to type in a keyword or two in a search field. The results are encouraging for providing keyword search also on mobile internet sites.

We are still looking for a best small screen interface for the case where the user needs to search for an item by a parameter value (in our case, offerings with no bids). Sorting would have been the most elegant method, but it was difficult for the participants to understand it.

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