

On the Paradigm Shift of Search on Mobile Devices: Some Remarks on User Habits

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Abstract. This paper addresses a paradigm shift in the way the web is being searched. This shift is occurring due to the increasing percentage of search requests being made from mobile devices, changing the way users search the web. This change is occurring for two reasons: first, users of smart phones are no longer searching the web relying on generic, horizontal search engines as they do on the desktop, and second, smart phones are far more aware of the user's context than desktop machines. Smart phones typically include multiple sensors that can describe the user's current context in a very accurate way, something the standard desktop machine cannot normally do. This shift will mean changes for the information retrieval community, the developers of applications, the developers of online services, usability engineers, and the developers of search engines themselves.

1 Introduction

As device mobility, power and capability increases, and the amount of web-based information continues to rise, more and more searches are being performed by users on the move, especially in certain areas such as healthcare. This paper will discuss the implications that this usage shift will have on developers and users alike, and will investigate the ways in which search is changing from a text based, horizontal search paradigm, to a context aware, vertical search paradigm.

2 Mobile Information Retrieval

In the *Future of the Internet III* report [1] the authors claim that the mobile device will be the primary connection tool to the Internet for most people in the world by 2020. According to [2] there exists two major concepts that differentiate mobile IR from standard IR, and each comes with its typical research fields: *Context Awareness* and *Content Adaption*.

Context Awareness deals with the fact that smart embedded devices have features that can make them aware of the user's situation at any given moment. This means that time, location, social status (via a social network), and camera input, etc., can be

used to shrink the search space or the space for an information need. Recent work completed by [3] involved making music recommendations based on the context from which the information retrieval process is started.

Content Adaption concerns how to visualize the results of an information need in a user friendly way, by optimizing content to suit the limited screen space on mobile devices. For example, in [4] the authors developed a block importance model to differentiate the segments of web pages in order to extract and present more condensed search results to mobile users.

Besides context awareness and adaption, mobile information retrieval systems must also make use of hardware components and device information: these include, but are not limited to, power awareness, multiple sensors and sensor fusion, computing power, and screen size.

3 Paradigm Shift and Its Impact

According to Nielsen¹, iPhone users have installed an average of 37 apps per device. For the most part these apps are games, but fewer still are apps that focus on what is known as horizontal search. Horizontal search is what is typically performed by most search engines, such as Google, Yahoo!, and Bing when a user makes a search request. Vertical search, on the other hand, is search performed on a much more focused information need. This is typically the case with mobile apps, as the context of the user's information need is already very well known, and the app itself can narrow the search space dramatically. In other words, users are focusing on apps to fulfill information needs, and are not relying on broader, more generic search engines to do this.

Other statistics show that search via traditional portals such as Google is in decline. According to comScore², there has been a 90% increase, in data measured over the same three month period in 2009 and 2010, in search usage through applications. It was also found that searches performed through the browser have increased by only 50%, with other areas such as social network access increasing by 90% in the same period. So while search usage is increasing rapidly on mobile devices, the usage of horizontal, web-based search engines is not increasing at the same rate. In fact, search is being accessed increasingly through apps, because apps are far better at knowing the user's context than a search field in a browser. To slow this trend, developers of search engines will need to be able to deliver more specific results depending on context, location, direction, time, and other contextual parameters.

Also of interest is the location of the search field itself within the interface design of some mobile devices. Search, while being a primary feature, may not necessarily have a primary position within interfaces, Apple's iOS being a notable example. The web search field on Apple's mobile OS occupies a secondary position within the interface, available through the browser. Google, on the other hand, and rather unsurprisingly, have not done this with their Android operating system. On Android, search has a central position on the device's "desktop". However, it remains to be seen

¹ http://blog.nielsen.com/nielsenwire/online_mobile/the-state-of-mobile-apps/

² http://www.comscore.com/Press_Events/Press_Releases/2010/6/Social_Networking_Ranks_as_Fastest-Growing_Mobile_Content_Category

whether users will embrace the search bar in the same way in which they have on the desktop, where almost all browsers make search a fundamental aspect of the entire user experience.

Of course, other ways of searching that do not make use of a standard text search field are being developed. Google, and others, are working hard to cater for users of mobile devices by offering products and services that are more at home on smart phones and tablets. A number of applications written by Google recently, including Google Goggles, Google Voice Search or Google Barcode Search, are typical examples of how search engine companies are making use of device components to transform information needs in new ways.

Considering the domain of medicine, Mobile IR also has the potential to alter the traditional interaction between the doctor and the hospital information system. As stated in [5] and [6] delivering content to mobile devices in an optimized way ensures increased legibility, but combining this knowledge with the enhanced context awareness of newer devices would ensure an even more tailored view of patient records for the medical professional. Health information systems developers must make their systems capable of much more than just text-based search: they must make their systems capable of taking many more parameters into account when a doctor performs a search, such as the doctor's whereabouts, to ensure more concise results are returned for a particular patient or situation.

4 Conclusion

The way in which search habits are changing on mobile devices will affect several areas of research. Information retrieval itself will be impacted greatly, as designers of such retrieval systems will have to cater for the increasing amounts of context information available to them from these new devices. This means that methods should be developed that will try to shrink the information space according to parameters supplied regarding the user's context. Developers of native applications for mobile devices must take into account the paradigm shift of search on mobile devices. They should understand that users expect applications to make full use of their context and that may not be as willing to perform horizontal searches to fulfill their information needs.

Content providers, who provide their services on the Web, must also be aware of how search is changing. They must ensure that they make available their content in such a way as to make it easy for application developers to a) have direct access to the information they provide (by providing RESTful services, for example), and b) make it easy for developers to supply the user context to the service. If content providers can allow context to be supplied along with the search term, it should be possible to return better results to the application. User interface designers must also be aware that users may not embrace the ubiquitous search field that is central to the user experience on all browsers in the same way on mobile devices. More innovative interfaces will have to be developed. Developers of applications for mobile devices will have two choices in this matter. An application could either search for content and filter the returned results according to the context of the user, or supply the user's context to the information provider along with the information need, in order to get

more concise results back from the provider. In most cases it would be desirable to receive more concise results back, simply for bandwidth and speed reasons. Content providers must therefore carefully consider how they will make their information available, and consider how they will design their content APIs to allow the user context to be submitted along with the actual search request. Last, developers of search engines must make it possible for applications to be able to supply user context to the search engine as a list of parameters.

Another developing trend is the ability of web-based applications to make use of device information and user context. HTML5's *geolocation* specification allows for web-based applications to determine the location associated with device accessing the website. Future work will consider the amount of context information that web-based applications can determine in comparison to natively programmed applications. Furthermore, future work is also planned to perform usability testing, where test users will be asked to perform searches on an iPhone or similar smart phone. Their behavior will be monitored to determine whether users are more willing to use apps rather than a generic search engine when searching, if a suitable, more specific, app is also available to them. Perhaps users will only resort to searching the web directly when a suitable app is not available.

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