WWW2002 Workshop on Mobile Search

Aya Soffer and Yoelle Maarek, IBM Research Lab in Haifa
{ayas,yoelle}@il.ibm.com

Bay-Wei Chang, Google
bay@google.com

1. Introduction

The dramatic increase in the use and availability of mobile devices such as cellular phones and Personal Digital Assistants (PDAs) in the last few years has resulted in the ability to access information anytime and anywhere. IDC, a leading provider of technology intelligence, forecasts that by the end of 2002 there will be more wireless subscribers capable of Internet access than wired Internet users. Yet, we are still far from the dream of having Web information as conveniently accessible from a handheld device as it is from our desktop. Existing information discovery mechanisms for searching and browsing the Web are not well-suited to mobile devices which are limited in terms of processing power and memory, screen real estate, input capabilities, networks and bandwidth.

The goal of the Workshop on Mobile Search held at the WWW2002 Conference in Honolulu, Hawaii, was to bring together researchers and practitioners interested in Mobile Search to discuss and define the most relevant issues in information discovery tasks such as search and browse on mobile devices, present recent results, propose future directions for research, and possibly standardization. Seven research papers were selected for presentation at the workshop, and the agenda was bracketed by presentations by the organizers.

2. Trends of mobile search

Aya Soffer opened the workshop by giving an overview of the current state and future trends of mobile search. In particular, she highlighted the need to devise mobile search paradigms that take into account information needs and connection modes specific to mobile devices. Common information needs include local search, unstructured search, and hierarchical browse and search. The predominant connection modes are disconnected, intermittently connected (the PDA synchronization model), and fully connected (wireless devices). She posed the provocative question of whether we really need Mobile search, and challenged the participants to address this question throughout the workshop.

Aya then described the data encapsulation model that has been employed in several solutions developed at the IBM Research Lab in Haifa. This encapsulation model is geared to intermittently connected devices and offers solutions for both unstructured and hierarchical search needs. The main idea behind this model is to encapsulate and download to the device enough knowledge so that most information needs can be satisfied locally in disconnected mode. A moderator component is used to maintain the freshness of the encapsulated data and to service new user information needs when connecting to the server.

3. User preferences

The first part of the workshop focused on user preferences. Since interaction on a mobile device has limitation of input, output, and speed (both latency and bandwidth), customized experiences can significantly improve the efficiency of accessing the desired information.

David Chan of Hong Kong Polytechnic University reported on a study of user preferences in mobile, small screen devices. David and his team catalogued the features of wireless content sites and had subjects visit those sites both on a PDA and on WAP-enabled phones. While more sites were found to use lists of information rather than directory-like hierarchical organizations, users seemed to prefer directory-style interaction more.

Johan Hjelm presented an ontology for iMode content developed by Ericsson and NTT DoCoMo. The purpose of the ontology is to enable searching for non-textual information, such as audio, and for related information that uses different languages or vocabularies. When metadata is attached to resources according to a well-defined ontology, search engines can fetch relevant information even if the documents are of widely differing types.

The DoCoMo-Ericsson Metadata Elements Set is an RDF-format metadata based on the Dublin Core Metadata standard that describes iMode content. In particular it adds to the Dublin Core three elements: *Creator*, *Device*, and *Rights*, and defines classes such as *MusicContent*, *MovieContent*, and *PictureContent*. These allow searching over potentially rights-managed non-textual content appropriate to the mobile device.

Invited speaker Juliana Freire of Bell Labs showed an approach for getting around the lack of device-specific versions of a website that does not rely on incomplete or error-prone transcoding tools sites. This approach is based on dedicated wrappers that provide an alternative means of delivering Web content, and is embedded in the "WebViews" system. WebViews allows users to record such wrappers that encapsulate a navigational intention (for example, "Travelocity fares to Honolulu" or "weather in Murray Hill, NJ"). Executing a wrapper fetches the relevant portion of the destination page. Accessing this "web clipping" via WebViews skips many of the navigational and form-filling steps that would be necessary when going to the destination via normal browsing. This makes them especially suited for mobile access, in which the devices have small screens and awkward input.

Web clippings still require transcoding in order to be displayed on a mobile device. However, since wrappers are manually recorded, there is an opportunity for the user to specify at recording time layout hints that will significantly increase the quality of the transcoded output.

Werner Kießling of the University of Augsburg then discussed how the "Preference World" research program could be applied to mobile search. It implements a "Best Matches Only" query model that weighs results by their fitness based on preferences (soft constraints) implied in the query. For example, a query such as "Give me the top recent insurance claim cases involving these people with similar kinds and costs of damages to the current case." Preferences identified in this query are *kind*, *cost*, *people*, and *time*. By matching these preferences with features identified in documents, a focused set of results can be obtained.

A similar approach can be applied to document delivery on small-screen devices. By using a user preference profile, structural

characteristics of the document, usage profiles, etc., the most relevant parts of documents can be delivered first.

4. Input/Output

The theme of the second part of the workshop was dealing more directly with the input and output limitations of mobile devices, both of which are much more restricted than that available on desktop computers.

Invited speaker Andreas Paepcke of Stanford University began by examining priorities for mobile device interaction. He pointed out the importance of facilitating input, of managing the scarce screen real estate, and of supporting Web search and navigation. Less important is support for traditional desktop applications such as spreadsheets and presentations and file management.

To address the input issue, Andreas described a technique using "prediction tables" which populates a table at the bottom of the screen with predicted words. His team at Stanford applied this method to email composition on a PDA (Power Email), for which the vocabulary used tends to be more predictable than for document writing in general. In addition, the overall inconvenience of composing a message on a mobile device usually results in succinct, more stereotyped messages. To send a short "let's get together for dinner" message (12 words total), Power Email required 38 user actions, compared to 109 user actions in other PDA email clients.

Prediction was also employed for word completion for search queries. After 2 or 3 letters are entered, the system fetches a list of candidate completions from the server. Again, this reduces the number of user input actions considerably required to initiate the search.
This word completion technique was used in the PowerBrowser, which focused on efficient input and navigation to Web information.

To address the output issue, Andreas described the novel "accordion" approach of the PowerBrowser system. This approach is based on the observation that users follow multiple links before they reach a desired page, and consists of presenting pages as lists of the links on the page. Selecting a link causes the links on the target page to be displayed inline, similar to navigating nested folders in a "tree view". Only when the user is interested in a page is the body of the page presented. The body is presented with "accordion summarization", an outline-style mode, in which segments of the page are represented as the first line of the segment. Again, the user scans these lines until the desired portion of the page is found, at which time a simple selection causes the line to expand into the full text. These techniques make efficient use of screen real estate for scanning and zeroing in on the desired information.

Oscar de Bruijn of Imperial College discussed three questions that users face when browsing a mobile device: Where am I? Where can I usefully go? And, Where have I been? The first question, "Where am I?" addresses the problem of displaying Web content on mobile devices. He proposes a hierarchical content description embedded in the page, each section specifying whether the server, the user agent, or the user decides whether the page should be downloaded to the device. This alleviates from the content provider the burden to design specific content for every mobile device; the information is selected dynamically at content delivery time.

The second and third questions are addressed by the M-RSVP technique for mobile Internet browsing. RSVP, or Rapid Serial Visual Presentation, is a technique for showing information sets by quickly displaying each element one after the other in the same

location. M-RSVP shows all the pages linked from the current page in this manner, allowing users to see and choose among them without tediously selecting each one. The user can also access browsing history in the same RSVP fashion for easy backwards navigation.

Jihong Kim of Seoul National University described the WebAlchemist transcoding system, which uses a series of techniques – both original and borrowed from other systems -to effectively transcode even complex Web pages such as the Yahoo or CNN home pages. Techniques adopted by WebAlchemist and that were applied in earlier systems, include transforms such as those used in Digester, restricted first sentence elision such as used in PowerBrowser, and indexed segmentation such as used in Google Wireless Search. In addition, WebAlchemist employs generalized outlining that can detect outline-like patterns of different types throughout a Web page, and selective elision that focuses on main content in table-based layouts. The latter technique is especially effective in preserving the general look of a page even after it has been greatly simplified for delivery to a PDA. For example, the Yahoo homepage after transcoding still preserves its general layout, with a search box at the top, tabled sections for different groups of links, a directory section at the bottom left and a thinner news and marketplace section along the right side.

5. Mobile search in practice

Bay-Wei Chang concluded the presentations with a discussion of mobile search in practice, his case study being based on Google's WAP search service, which has been in use since mid-2000, allowing search and browse access to the entire Web. As was touched on many times in this workshop, major issues included optimizing search display for small screens and dealing with poor input capabilities. Dealing with WAP's limited page downloading size was also discussed. Google Number Search addressed the poor input capabilities of phones, by permitting users to press a single number key per letter, and allowing Google to disambiguate among the possible letters in the word.

6. Conclusion

The workshop ended with a discussion of the themes brought out by the presentations. Participants agreed that preferences and customization are highly effective ways to streamline information access using a mobile device. More targeted search strategies, such as focused search, preference-driven search, and metadata labeling, promise to help users find good results even when limited by the speed and display limitations of mobile devices. Smart elision of information helps users navigate quickly to the pages and sections they are interested in. Finally, novel navigation techniques (such as WebViews) and display techniques (such as M-RSVP) suggest that mobile search can benefit from very different kinds of interactions than are practiced in "traditional" Web search. The participants all agreed that mobile search is indeed a necessity and will become even more so when devices become more widely used. Bringing mobile search into the enterprise may provide the "killer application" needed for mobile search to become an everyday commodity.