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Mobile Search Browser

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Abstract
Web service is a popular standard to publish services for users. However, diversified users need to access web service according to their particular preferences. Mobile search is quite different from standard PC-based web search in a number of ways: (a) the user interfaces and I/O are limited by screen real state, (b) key pads are tiny and inconvenient for use,(c) limited bandwidth and (d) costly connection fees. These limitations result in more navigational queries in the mobile search. Mobile search is becoming increasingly important for mobile users as mobile devices are more widely used. Most importantly, user ontology with both static and dynamic information is defined by web ontology language (OWL), through which the location server can do Personalized search of services. A UPL is an indispensable source of knowledge which can be exploited by intelligent systems for query recommendation, personalized search, and web search result ranking etc. This paper focuses on the personalization strategies which explicitly and implicitly infer user search context at individual user level. We propose an architecture which collects user information (at mobile device and carrier network) and derives user intention in given situations. We show that personalized mobile search perform well for ambiguous queries and localized searches.
Keywords : Mobile Search, Personalized Search, Context Awareness, User Profile.

I. Introduction

Researchers have explored personalized search to improve topical relevance of result documents in PC based web search. The user's immediate and short-term search context to expand the current query mechanism based on the user interest. Chirita et al. [9] proposed personalized search and summarization algorithms which assist based on extracted information from local desktop. Mobile search is the second most used application only after social networking in wireless internet .Search engine like Google appears in top three of the most visited web sites in terms of wireless internet usage. Most mobile are short due to the hardware limitations such as tiny keypads and small screen. The top 100 mobile queries at AT&T [3] reveal that a great number of search queries are navigational [4] in nature. The navigational searches, for example "Google and Bing", usually steer mobile users to Specific web sites conveniently. Unlike navigational queries, words like "software" and "free" that are informational and transactional are ambiguous to search engine. A housewife and an iPhone user interpret "apple" differently in search context. A housewife is likely to know the apple variety and prices at the local grocery stores. While an iPhone user is interested in service or products related to iPhone.

A variety of contextual information is acquired through various sensors such as a GPS device, temperature, noise, and air pollution and interacting with other application services such as weather and traffic services based on Web services technology. The data transmitted from other sensors, with the exception of GPS sensors, can not be generally used in context aware systems without the installation of sensors and construction of wireless sensor networks even though the data provide more contextual information. For this reason, most approaches of context-aware systems have service-oriented architecture based on Web services with context information We propose a smart proxy on the wireless device to derive user context profile. A dynamic neural network based algorithm is utilized to the user's given situation, location, activities, and history information.

II. Architecture Design

The mobile devices play an extensive role of collecting, analyzing, and extracting context entities. Context profiles compiled at client side adapt to the mobile user's current situation.

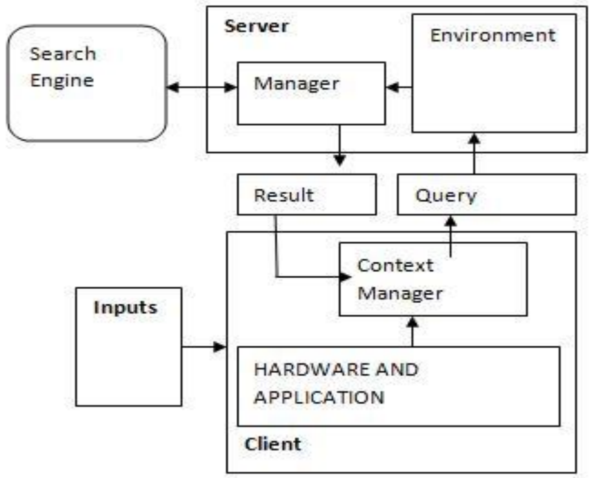


Figure 1: Proposed System architecture

Figure 1 shows the paradigm of the client/server model. The user inputs (voice or data) and surrounding environment inputs (temperature, GPS reading, altitude,e.g.) are collected by the hardware logic or the applications such as the user calendar. The traditional client/server paradigm fits well into the mobile search application. The carrier's network is the server which provides data and voice services to subscribers. User submits mobile queries to network. The context aware proxy further inspects inputs and extracts context entities from the inputs. Finally, the proxy compiles the context profile and sends it to the carrier server.

The carrier server learns the user situation from the context profile in addition to data collected at the network. For example, the network context unit collects user information, i.e., location and query history. The intelligent manager carries out a few important functions such as identifying the ambiguous queries and expanding these queries with context profiles. Expanded query contains extra information which could facilitate search engines and improve the topic relevance of returned documents. duo et al. [10] and Teevan et al. [11] investigated the personalized search strategies and stated that personalization improves the search accuracy on ambiguous queries. So far the personalization is studied only for PC based web search.

Most of such personalization strategies are limited to the user search history, returned search results, and documents stored in PC. We extend this line of work into mobile search and derive user context based on profiles which adapt to user location, activities, interaction history, and preferences. We also believe that the increased usage of location-based applications and services will lead mobile users to search for local services and information. Liu and Birnbaum [12] developed Local Survey which aggregates local views associated with news events or topics. Vadrevu et al. [13] pointed out the importance of identifying the regional sensitive queries. Hence, the mobile search must cope with local search query .We propose a proxy on the wireless device to derive user context profile

III. Manager

One of the trends in the wireless device is to integrate more sensors, e.g. tilt sensor and touch screen LCD on iPhone. The software applications on wireless devices advance in parallel. Hence, context proxy on wireless devices is able to collect user information, analyze user search context, and compile context profiles.

3.1. Profiles

The profile [14] is a collection of context entities extracted from the on-board sensors, client applications, user activities, and so on. Ideally, context profiles should be a good reference of user's current situation from which the carrier's network could derive user's context or intention.

Thus, the proxy on mobile devices frequently updates context profiles and uploads them to network for reference if necessary. Due to the limited bandwidth [15], the context profiles should be concise. As user changes activities/context, context entities are added to or dropped from the profiles based on the algorithms we specify in the later section. Whenever addition or deletion of context entities occurs, the proxy notifies network the changes.

sent to network. There are four context profiles managed by the client proxy;

1. User profile describes the user's habits and emotions In addition, this profile includes the software applications and user interfaces. Examples of context entities in this profile are processor, memory, display type, device size, and OS.

2. Profile describes of context entities in this profile are processor, memory, display type, device size, and OS.

3. Environment profile describes surrounding area of the mobile user. This profile stores user location, weather, noise level, or temperature, etc.

4. Data profile caches user's data in the local memory.

3.2. ANN Algorithm

Artificial Neural Networks (ANN) are widely utilized in many of today's novel applications for solving practical problems, such as pattern recognition, classification, forecast studies, and cluster analysis. The learning rule is based on the following general equation:

ΔWij (t) = xi(t)yj(t) (1)
We modify xi(t) as a function of the context changes DC

and frequency count Δ*F* of the context entities in the context cache managed by the client proxy between the current epoch and the previous epoch. In addition,yj(t) is defined as the weight values, *reference W* , in the current user situation.

Thus, the derived equation of weight change for our approach at epoch t follows:
W (t) C(t) F(t) ( ) k , *W t |k k reference*
Δ = Δ + μΔ (2)
where DC(*t*) is calculated ascurrent user situation. Thus, the derived equation of weight change for our approach at epoch t follows:

ΔW (t)=| ΔC(t)+m ΔF (t) | k , *W k k reference* where DC(*t*) is calculated as

$$\Delta C(t) = \frac{|C(t) - C(t-1)|}{C(t-1)}$$

ΔC(*t*) is the current context value, and *C*(*t* -1) is the previous context value. If DC(t) is zero, then

ΔC(*t*) = -|*C*(*t*) – *C average*| .

C average is the mean of C(1) through C(t-1). Δ*F*(*t*) is the difference in n frequency counter for context entity between

at current epoch and previous epoch, Δ*F*(*t*) = *F*(*t*) - *F*(*t* - 1) .

μ is the coefficient that is machine specific. Finally, the weights for context entity k at epoch tare updated as

Wk(t) = Wk(t-1) +Δ Wk(t) (3)

If the current user location contributes new context t weights that do not exist in the previous context setting, then the initial value of Wk(t) is set to 1.Environment profiles, user profiles, and data profiles are updated based on the above equations such that these profiles adapt to current user situation. Ambiguous queries submitted to the search engines are expanded with the more user information from these profiles.

IV. Manager

Manager is the most important component at the carrier's server side. It learns the mobile user's context information at the network level and analyzes the next profiles sent from the client devices. When mobile user submits query anager indentifies the ambiguous queries and further expands these queries with derived user context. The expanded queries are then submitted to search engines

4.1 Search Query Expansion

The context profiles compiled by proxy at client devices reflect the hardware configuration, user applications, usage history, and derived user situation.

Higher weights mark the importance of context entities. Of course, not all context entities in the profiles have changing weights. The hardware profile has weight fixed context weights due to the stable hardware and software configuration at the client device. Context profiles include the weights of the context entities calculated at proxy, p = [CWi+1, CWi+2, CWi+3,

… , C Wi + n], where i _ [0, 1, 2, 3…]. Let the query forms the set, q = [T1, T2, T3, … ,]. After query expansion, the augmented context profile is

$$AP = \sum_{i=1}^{m} CW\,i + \sum_{i=1}^{n} K\,(\mathrm{Tj}) \quad (4)$$

where K(Tj) is the offset function. An example augmented context profile could be AP = CWi+1,CWi+2+ K(T2),

CWi+3, … , CWi+n, K(Ti+n+1), …]. If the terms/words from the query set are matched in the context profile, then the offset weight of the term/word,K(Tj), is added to the context weight, CWi+n. Furthermore, if the terms/words from the query set are not found in the context profile, then the offset weights profile. It is obvious that the augmented context profile is likely to have more weights on the query words.

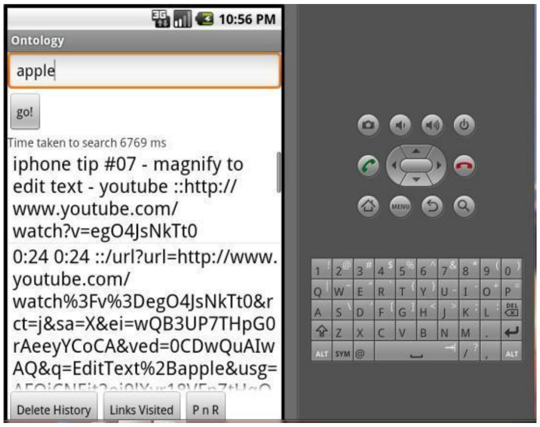
4.2. Documents Ranking

The search engines return all the documents related to the query based on the augmented context profile. The returned documents are grouped into categories and ranked in terms of descending weights in the context profile. Categories that match more context weights in augmented context profile have higher rank.

Because most mobile devices have small displays, the maximum documents in each category are limit to a number. This method relies on the user selection to further narrow down user current context. When the user selects the data or services downloaded from the server, his/her selection would greatly help the system understand user's intention. Hence, it is important to utilize the user's selection, as feedback, to adjust context weight calculation at client and server sides. The server embeds the calculated context weights in data to the user device. The embedded context weights are transparent to users. However, the user selection on the data allows the related context weights to feed back into the proxy. This feedback mechanism significantly improves the accuracy of the server response.

V. Experiment

In this scenario, the user carrying. During this he submits search query. "apple"



The returned documents show that the personalized search results include documents related to the mobile query. Key word "**apple**" is ambiguous without specifying location. Because the location is included in the user context, then the search engine understands it is a search in area. In addition, the context profiles reveal another important topic which is food. Thus, the returned documents also include links related to food or restaurants in the local area. The context profiles assist the search engine to provide local information.

VI. Conclusion

With the wide spread of mobile devices, mobile search becomes an important application for mobile experience. Mobility, social activities, and locality add to the sophistication of mobile search. Personalized search has been the focused approach for PC-based search lately. We extend this line of work to mobile search. We propose a client-side context proxy which collects user information, analyses context information, and compiles context profiles. These context profiles, which reflect user current context, assist query expansion to solve ambiguity. An intelligent manager is proposed to process context profiles, identify ambiguous query, expand query, and reorder the result documents based on user current topics in the context. The simulation result shows that the proposed architecture can adapt to user situation and provide local information for mobile search.

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