

A Context-Aware Search System for Smart Phones Based on Context-Aware Infrastructure

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Abstract— The major objectives behind designing the context-aware architecture are to: i) collect the mobile user's context information, ii) derive a meaningful & a usable current context from user's accumulated context information, iii) replicate and/or distribute this current context information among the context-aware systems and thereby, support building a context-aware platform that delivers search results which are closer to the user's current context & are more specifically tailored for user's current search semantics. The user's context information is maintained & updated at the server, so as to reuse it across different context aware backend providers. The process of context reasoning, itself takes place at the application level. By implementing context-aware architectures, applications can derive user context profiles. Such user context profiles can be integrated with the 3rd party search providers like, Yahoo search engine or the ones plugged into the platform to meet the users' demands for the services and products they are searching for around.

Keywords— Context Aware Architecture, Context Information, Context Reasoning

I. INTRODUCTION

The concept of context awareness originally stems from the research of human-computer interaction (HCI). One of the objectives in HCI research is to design computer interfaces that reduce user intervention while providing more relevant services to the user. "Context is the set of surrounding states and settings that either determines an application's behavior or an application event occurs in which the user is interested". In computing, "context" reflects the mobile user's current state including physical behavior, mobile applications based on the explicit and implicit input, artifacts, social interaction, surround events, and environment.

As mobile devices are becoming ubiquitous & are being widely adapted, set of context notions has very limited success in learning the mobile user's intention under various scenarios. The main objective of the proposed system is to develop a context-aware search application which can provide data and services relevant to the user's personalized profiles and history of search. It is not easy to single out the mobile user's context from objects and entities which are not relevant to users' intention [2].

Mobile users have different knowledge, expectations, experiences, skills, priorities, social roles, attitude to view the world surrounding them. Hence, individuals select the objects in the real world in a subjective way and describe context of the world complexity in an unstructured fashion.

Context-awareness is the ability of computing systems to acquire and reason about the situational context and adapt application accordingly. Context-aware system comes with gathering of low-level contextual data, interpret the low-level contextual data into high-level interpreted context, reason the interpreted context to derive results and adapt the application behaviour on the basis of the implications.

II. BACKGROUND

People tend to use mobile devices for private information in office where wired computers are available. The mobile search started as the wireless extension of the PC-based web

search. Major search engines such as Google, Yahoo, and MSN attempt to increase local content in the query results in the hope that users are provided more information around them. The proposed context-aware search manager improves the mobile search by personalizing the user query. In the traditional query expansion, the user query is expanded with additional terms from the thesaurus or a set of documents. The proposed personalized query incorporates the user profiles. The context profiles should help improve the search results, because they provide information related to hardware configuration, user activities, cached data, network traffic, surrounding area, and so on.

III. CONTEXT-AWARE SEARCH MANAGER

As the information exponentially increases on the World Wide Web and beyond, people rely more on the search engines to find the information they seek. Mobile web refers to user's web access via mobile devices. The mobile web access is hyped as a promising service which will eventually dwarf voice calls and short message services. Wireless users enjoy the access to the mobile web "anywhere and anytime" due to the mobility. Recent research shows that mobile web access provides one additional usage dimension to the mobile users, personal space extension [6]. The personal space extension refers to the mobile web access anywhere and anytime in places with or without stationary PC.

A. Context-Aware Mobile Search

Due to the concept of mobility, mobile devices are utilized in more diverse contexts than PC in office and home. Mobile search is becoming increasingly important for mobile users as mobile devices are more widely used. Mobile search differs from standard PC-based web search in a number of ways.

The user queries are classified into three major categories. The first type refers to queries that cover one unique topic. Navigational queries fall into this category. The second type of queries is referring to sub concepts or sub topics of one particular thing. The third type of queries is

ambiguous queries which cover multiple topics. Search engines have hard time solving ambiguous queries.

B. Personalized Search Query

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

C. Reorder Document Set

Google and Yahoo provide API for programmers to integrate search functions into various applications. Yahoo search engine returns documents to intelligent manager via its API. Since the returned documents, in general, might cover multiple topics in no particular order, the intelligent manager processes these documents according to the context profile. It ranks the relevance of the returned documents and reorders the documents in the set. The documents that are most related to the current user context are returned to the user first.

D. User Feedback

Mobile users do not actively provide the feedback to the search engines. Hence, a system is developed to implicitly collect user data. 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 side. The user selection on the data allows the proxy to reflect the context change into the weights. This feedback mechanism significantly improves the accuracy of the server's response.

IV. CONTEXT-AWARE SEARCH APPLICATION DESIGN STEPS

The steps considered in this context search-aware application include:

- 1) Mobile user submits a query to the wireless carrier's network from the mobile device.
- 2) Carrier server detects the user query and passes on the query to the context manager.
- 3) Context manager further sends user query to context-aware search manager.
- 4) Context manager interacts with context server from the required context-aware infrastructure to requests or updates the mobile user in the mean time.
- 5) Context server sends user context data back to the context manager. Context manager updates the user context.
- 6) Context-aware search manager verifies that this is a query to be solved.
- 7) Context-aware search manager goes on to check if user context data are available.
- 8) If user context data are available, then Context-aware search manager retrieves and processes the user context.
- 9) Query manager is activated to augment user search query with current context.
- 10) Query manager notifies search manager that augmented query is ready.
- 11) Search manager receives notification.
- 12) Search manager further submits augmented query to the search engine (i.e., Yahoo) using the Yahoo API.
- 13) Third party search engine (i.e., Yahoo) returns document

set to search manager.

14) Search manager further checks if the mobile user or other users had the same query before.

15) If same query was submitted before, search manager retrieves saved documents related to the query from database.

16) If there is documents set retrieved from database, then merge the documents with search result from the search engine. In addition, documents are reordered. Documents that are relevant to the current user context are listed first.

17) When the document set is ready, notify the search manager.

18) Search manager is notified.

19) Search manager sends the document set to the carrier network.

20) Carrier network is notified.

21) Carrier network passes the document set to the user's mobile device.

V. CONCLUSIONS

Context awareness within this design concept defines the user context in a changing environment under different situations, and provides solutions for useful applications. Context data acquisition in a cost-effective way using current technology is highly feasible.

The context aware architecture at the server side provides a platform to share the user context among context-aware applications. Context reusability shields application developers from low level context acquisition. The required architecture is envisioned to accommodate third-party service providers. Service provider could register their services and products with the designed architecture.

Furthermore, in order to address the issues of variability and instability in the notion of user context, the approach considered addressed the source of the difficulty in context awareness at the client side through the extraction of useful feature/context from user situations that are dynamic in nature.

To meet real-world needs required of a testing environment without the imposition of a heavy cost such an infrastructure will demand, a free Yahoo search API is thus integrated as a means to evaluate the effectiveness of the proposed design structure in a most realistic way.

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