A Collaborative Framework for Location-Based Services

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Abstract. This short paper is aimed to discuss the challenges for location-based services and proposes our framework, which makes it possible to obtain information from heterogeneous sources, and further set up the collaboration between *Data Repositories* and derived *Top Hits Repository* to improve the request-response efficiency. In our framework, the Data Handler, Profile Manager, Data Repository and TOP Hits Repository are key components. Through analyzing user profiles and location, Data Handler can locate suitable data sources and keep frequent queries and their answers in TOP Hits Repository for later requests.

1 Introduction

Due to development of mobile technology, the availability of the variety of spatial data, as well as human 's nomadic instinct, humans have not been merely satisfied by such simple services as receiving email, checking weather information using mobile device or obtaining information from desktops. It heralds that the ubiquitous computing [1] era is coming to us at an accelerating pace. As an important part of ubiquitous services, location-based services become emergent.

Initially, the location-based services[1] are focused on consumers' requirements, e.g. tourism guide [2], roadside assistance and entertainment appliances. However, as the technology is maturing and pervasive, we can witness that it will be extensively used in business, government and industry (e.g. mobile office, emergency response and traffic monitoring etc.)[3]. Relevant research and approaches have been proposed. In the DBGlobe project [4], Pfoser & al. put forward the data-centric approach to global computing, in which the ad-hoc database model is central to exchange information between the Primary Mobile Objects in the specific community. Stockus & al. [5] propose the framework of a web-based navigation and spatial data visualization, and introduce data caching and spatial query restrictions to improve the transfer and

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presentation of spatial data. In the GUIDE project [6], the system uses WaveLAN as communication infrastructure for information exchange based on the traveler 's location and preferences. However, there are still open questions. In this short paper, we discuss the key technical issues of applications from data mining and management perspectives. Then we introduce our collaborative infrastructure for location-based services. Finally, we present the future work and conclusions.

2 Research challenges in Location-Based Services

At first, it is critical to make clear how to define location-based services. It is commonly approved that *Location-based services, or LBS, is the ability to find the geographical location of a mobile device and provide services based on this location*. Thus, LBS has to solve following problems:

- Semantics in heterogeneous sources,

Data exploration brings us both the rich content (e.g. text, GIS, web pages and graphic tables etc.) and excessive choices. For data's diverse formats, we propose to use ontologies to suggest the semantics of things [7]. However, there is no fully satisfying solution or taxonomy to deal with all existing accessible data.

- User profiles' expression and application,

Generally, users can be categorized into several communities according to motivation, spatial and temporal constraints, profession and ability. User profiles describe both the types and content of user-preferred data. The issues here are how to define visual user profile language and intelligent processing strategy [8].

- Caching and prefetching in the mobile environment,

In location-based services, mobility is one of essential characteristics. This change of position will influence and even trigger some events. If a user makes the time, route, velocity and constraints available to the system, the services can intelligently compute, predict and decide for the user considering all relevant information (e.g. weather, traffic etc.). Caching and prefetching are just good answers [9].

- GI-bound and region-dependent constraints

Human's activities are confined by spatial ranges and geographical constraints. When we attempt to search some places, more often do we use propositions like within, near and cross to build up the cognition maps in our minds [10]. Further, more of hits are region-dependent and relevant to local background. For instance, most of tourists to Lausanne will pay attention to places in the city or nearby (e.g. Geneva or Montreux).

3 A Collaborative Framework

For the location-based services, the first question of a user is often 'Where am I'? And then 'Where will I go'? 'How to get there'? The series of questions are simple but fundamental. However, in our work, our attention is not focused on building and

controlling the network and embedding GPS technology to the services, but on how to efficiently manage the data and reduce the cost and response delay.

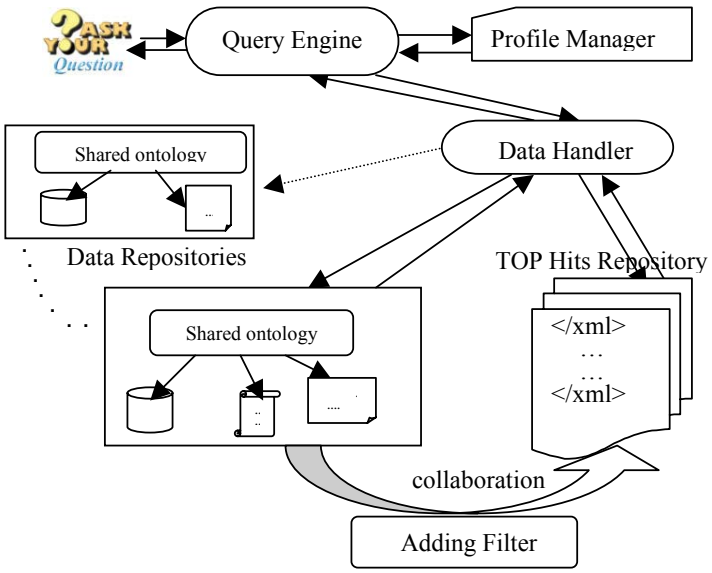

Fig. 1. A collaborative framework for location-based information management

Therefore, we propose the following framework, which deal with data management using ontology and information derivation according to user queries.

- **Query Engine**, to locate the user according to the GPS data, analyse and decompose the query based on the user profile and his/her actual location. We assume that every query message is composed of user's position, user's profile and user's request body. In LBS, the user's current location is significant since most of queries have evident region-dependent characteristic. Usually users care about surrounding and objects within the current or neighbouring city or region.
- **Profile Manager**, to analyse and define user profiles. The format and domain of user profile should be consistent with the *Profile Manager's* specifications. Thus, the Profile manager can provide some hints to the Data Handler by analysing the specific user profiles.
- **Data Handler**, to locate data sources. It keeps the organization hierarchy of local or even global data sources. It firstly checks *TOP Hits repository,* if not exists, find information from data repositories according to the query' semantics.
- **TOP Hits Repository**, to keep frequent hit queries and their answers, which are in XML or GML format for quick response and further modification. TOP Hits Repositories can be differentiated by their regions or domains. So the information in TOP Hits Repository is mainly derived from data repositories. Further, TOP Hits repositories also reflect changes of users attentions in particular duration.

- **Data Repository**, to organize and manage data from heterogeneous sources using ontology. Each data source has its own local ontology to specify the content of its data. However, they are grouped by the shared ontologies. The approach can make it easier to access to relevant data sources, as is discussed in [7].
- **Adding Filter**, to evaluate and decide if an answer can be added into TOP Hits Repository. It serves as a mechanism to count the frequency of a query and be responsible for transformation from data's original format to XML or GML format.

4 Future work and conclusion

This short paper is aimed to discuss the challenges in location-based services and propose our framework, which makes it possible to obtain information from heterogeneous sources, and further set up the collaboration between Data Repositories and derived Top Hits Repository to improve the request-response efficiency. Our work on progress is to define the user profiles language specification and investigate how to apply it into query optimization. On the other hand, we will experiment the extraction of spatial data from diverse data sources to create a spatial information repository using XML and GML (Geography Markup Language).

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