# User Profiles in Location-based Services: Make Humans More Nomadic and Personalised

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## Introduction

The rapid expansion of WWW has unobtrusively influenced humans' socio-economical life patterns in the last decade. With the development of portable phones, PDAs and laptops, Humans cannot be satisfied anymore simply by rich and exact access to the information. They look today for the more dynamic and personalized services on the move. Thus, the ubiquitous computing approach [1] is becoming emergent and popular. As one of its significant components, especially due to its dynamical characteristics of the space, time and contexts, location-based services (LBS) [2][3][4] emphasize the ability to take into account the spatial, temporal and contextual characteristics of their interactions with the users to provide the most appropriate service based on the local environment. Their location-centric approach distinguishes them from the traditional research on web information retrieval and personal navigation [5][6].

A key point of improving LBS is how to tailor the contents and representation to individual's specific spatio-temporal context. In the literature, some research [6][7][8] has been using user profiles in information filtering. In this paper[1], we attempt to flexibly specify the user profiles in XML Schema, and then apply them to refine the queries considering the particular space and time constraints, finally make the mapping between the pre-processed query and data. Simply stated, the user profile serves as a bridge between the generic queries from the diverse users and the heterogeneous data.

## Proposition

Figure1 illustrates the architecture that describes the approach we propose.

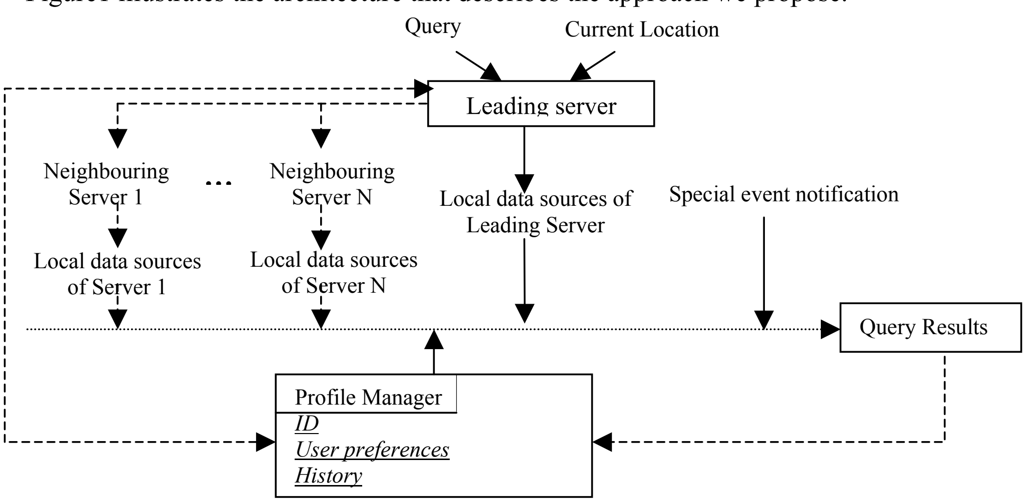


Figure 1. User Profile-based framework for the Location-based services

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*How does it work?*

We assume the mobile user inputs the query with a PDA, and that the current location can be encoded in both the geographic coordinates (x, y) and real address (e.g. street, NPA, city), thanks to transformations implemented by some encoding services [8]. The PDA on the move is in the ad-hoc networking environment. The *leading server* is the nearest one to the mobile user and able to identify its activity scale and understand its questions. Then this server will check user's preferences acquired from the *Profile Manager* and further refine the query, and then deliver the processed one to the local query-processing server. If the local server could locate the right information for the user, the results will be computed and returned to the user. Otherwise, the leading server will broadcast the refined query to its geographically *neighbouring servers* (But the neighbouring server can become the leading server as the user moves). These servers will do the similar operation until they find the relevant information. Special events that may influence user's current activities (e.g. traffic and weather) are notified by some local database to the leading server.

*How to specify the user profile?*

The user profile is uniquely identified by an *ID.* Its content is composed of two parts: user's preferences and history activities. They can be stored either in the PDA (client) or in the Profile Manager (server). The user can update the preferences according to his/her specific contexts. Table 1 below is a part of a user profile instance, which simply describes a traveller's preferences. The history is ordered by time-space and theme (e.g. conference). It records the activities in long run (e.g. one month or week) or in short term (e.g. one afternoon), as episodes and events, as defined in [10].

```
......
<xs:element name="DynamicData" type="DynamicDataType"/>
<xs:complexType name="DynamicDataType">
<xs:attribute name="ValidityData" type="xs:dateTime" use="required"/>
<xs:sequence>
<xs:element name="Interests" type="Interest"/>
<xs:element name="PrefferedRestaurant"/>
<xs:element name="PrefferedTransports"/>
<xs:element name="Time Constraints"/>
</xs:sequence>
</xs:complexType>
......
<xs:complexType name="Interest">
<xs:sequence>
<xs:element ref="Museum"/>
<xs:element ref="Sport"/>
<xs:element ref="Chinese Food"/>
</xs:sequence>
</xs:complexType>
```

Table 1. An instance of user profile

*How can we get the data?*

The local servers only keep the local information available and possible links with other neighbouring servers. To reduce the noise in the data collection, the data is categorized into hierarchies using ontologies [3] and can be indexed by timeframe, as illustrated in the example shown in Figure.2. In the figure, the left part shows a class 'Restaurant', which can be described and indexed by the temporal attributes (e.g. opening hour and seat available), spatial attributes like *location* and other general ones like *class* (e.g. four star) or *style* (e.g. café house, fast food or formal restaurant). The right part illustrates the temporal characteristic (i.e. opening hours in grey) of the different restaurants. Furthermore, the server can predict the busy hours from statistical data which will partly suggest users choices. In literature, the approaches of extracting the semistructured data have been discussed in [11][12].

With the reference to a GIS system, the server can provide the list of 'the nearest restaurants' and transports routes and relevant timetables to guide users finding ways.

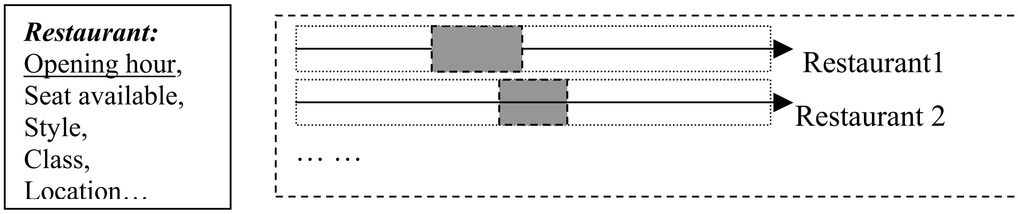


Figure 2. The relevant Entity with its temporal attributes

*How to map the queries using profiles?*

```
… …
For $r in doc ('restaurants.xml')
// restaurants_tuple
WHERE $r/city='Lausanne'
Return
    <restaurants_tuple>
            { $r/ Name}
            { $r/ Address} …
    </restaurants_tuple>
… …
   <<Original user query>>
```

For example, when the user asks for the nearest restaurant, the server will find out that the user prefers Chinese food and then deliver this refinement to the leading data sources. The leading server checks all restaurants and ranks them by opening hours, locations and styles. Finally, the server sends the results to the end-user.

```
… …
For $r in doc ('restaurants.xml')
// restaurants_tuple
WHERE $r/city='Lausanne'
And $r/style='Chinese food'
And $r/distance='20-minute walking'
And $r/mode='seat available'
Return
    <restaurants_tuple>
            { $r/ Name}
            { $r/ Address} …
    </restaurants_tuple>
… …
<< Modified query with profile>>
```

## Conclusion and future work

In this paper we propose a profile-based approach to improve the LBS 's efficiency. Regarding data organization issues, we use a relational database to keep user's history activities and alleviate the queries matching in XML format. However, we still have to tackle some critical issues in our future work.

- To investigate the different standards for user profiles and improve the user profiles' specification in the context of LBS.
- To make the mapping between the user profiles and the ontology of local data.
- To extract and analyze history to track users' preferences and activity patterns in specific contexts.

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