Wireless On-Line Information Support of Mobile Users

PETER MIKULECKÝ
Faculty of Informatics and Management
University of Hradec Králové
V. Nejedlého 573, 500 03 Hradec Králové
CZECH REPUBLIC
Peter.Mikulecky@uhk.cz http://www.uhk.cz

Abstract: - The aim of the paper is to present some information about a modern approach of information support to mobile users – travellers, equipped by a mobile end-user device (e.g., mobile phone with WAP or GRPS connection, together with handheld or notebook). The presented approach is a basis for a recent ongoing 5th Framework project HYPERGEO, aiming to develop rather general technological solution for such mobile information support.

Key Words: - Wireless Communication, Mobile Users, Wireless and Location Dependent Information Systems

1 Introduction

Recently, as Mountain [6] pointed out, in parallel with changes in the telecommunication industry, there is a significant shift in the portability of computers in the form of personal digital assistants (PDAs) or handheld computers. This situation is very much in favour of the introduction of a number of new technologies. One such technology is location sensitivity, where devices are aware of their location in space, offering thus a possibility to inform users about the existence and location of services that are accessible to them. Based of this, a number of tourism oriented information systems appear recently as a result of several projects of such new technologies applications. It is especially in the field of tourism where people are looking for easy and portable terminals for access to an on-line system capable to offer information relevant to the site, location and in user friendly way e.g. in the language of the person concerned.

One of the recent ongoing projects devoted to the development of a technology suitable to provide wireless on-line information services to mobile users is the HYPERGEO project in the scope of the IST program of the European Union (see its Web home page [4]).

In the paper some information about the recent results in the HYPERGEO system development will be presented as an example of an on-line wireless information system for supporting mobile users.

2 Research Motivation

Document routing is an important problem in the field of information retrieval. When a user has marked various information (say, documents) as relevant to his/her information need, a system should be able to automatically learn the user's "profile" and should be able to route (send) new, potentially interesting, documents or other kind of information to the user. This problem has also been called as selective dissemination of information or information filtering [1].

In the case of documents, most current state of the art routing algorithms first learn a user profile from the training examples, i.e., the articles marked relevant by the user and the non-relevant articles. This learned profile, also known as the routing or the feedback query since it is obtained using user's relevance feedback, is then matched against all the new articles that a system encounters. If a new article matches the user profile adequately, then this article is assumed to be of potential interest to the user and is routed to the user [8].

However, in the case of on-line information or on-line help to the user, the approach using training examples probably would not be effective enough. It is therefore necessary to use sophisticated methods of machine learning, where an initial user profile, created e.g. on the basis of a brief questionnaire, is subsequently improved and refined by monitoring and evaluating user's actions, and by comparing them with analogous situations in the user profile database. In a combination with various data mining techniques, or with various techniques of soft computing (see, e.g., [3]), such approach could lead to a rather finely grained profile, very suitable for targeted delivery of information and assistance using an on-line web-based communication device.

It has been a challenge to design and develop a technology which, based on a broad usage of recent Internet technologies would be useful for a mobile user, equipped by a wireless communication device with an instant possibility of Internet connectivity. The HYPERGEO project intends to create a ubiquitous traveller's information source, filtering and delivering her or him necessary, context aware information, sometimes of inevitable importance to the travelling

user. In what follows we shall present some essential points from this still ongoing project, which is planned to be finished at the end of the year 2001.

3 Hypergeo Project

3.1 Purpose

The European Union Information Society Technologies Programme (IST) funded HYPERGEO project aims to develop a prototype for the delivery of location and user sensitive information for tourists. To achieve this aim a distributed architecture has been adopted with different components focusing on specific problems associated with delivering timely and relevant information in a user friendly way.

The HYPERGEO project is recently on its second and last year of development. Recent experience shows that a powerful and useful service for tourism support has been developed.

First, a powerful information service for travellers based on the context – aware user modelling technology for mobile user support is being developed. The context – awareness means that a user, in a particular situation, will be supported with such a kind of information which contents may potentially help the user in solving the possible problems in that situation. For instance, if, when driving a car, an accident appears, the HYPERGEO service can offer all the necessary information, incl. necessary phone numbers, procedures inevitable to undertake not to break the law, addresses of hotels nearby with a possibility to book a room, etc.

Second, a convenient access to a body of other useful information is provided, partly based on a push service, deriving the delivered contents from the user's preferences, partly giving the user a possibility of pulling various interesting information via a specialised component of the HYPERGEO system.

3.2 General Architecture

As already mentioned above, the HYPERGEO system architecture consists of discrete components linked by various middleware protocols. Each component is intended to operate independently and communicate to other components through message sending.

A main user interface to the Hypergeo service is the web portal based on HTTP. Through the web portal various Hypergeo services can be accessed from a number of different devices, for instance via a static PC or using a micro-browser on a PDA. Pages are generated dynamically to take account of the user's location, preferences and queries. An important part of the whole system creates the user profile database, which stores information about the user and allows other Hypergeo components to access this information. Information about the user falls into three areas. Short-term information includes information about the user location and recent spatio-temporal trends. Mid-term information stores user preferences that can evolve over time. These preferences are based on the user's choice, but in the future also some automatic adaptive feature is planned, capable to extract the preferences from particular user's requests history. Long-term information is information on the user identity that is unlikely to change frequently.

The user profiles database will be one of most valuable parts of the system, residing at the hardware of a particular service provider. A powerful market profiling system, based on a data mining approaches will allow to mine the data, creating thus a bulk of valuable knowledge possibly useful for provider's market strategies improvement.

The component devoted to users' geographical location tracking is described in detail in the paper [6]. According to it, users' geographical locations are sent periodically by mobile users' devices and their profiles are updated with this information. This makes the user's present position available to all components in the Hypergeo system. In addition a track log history is stored but this information is degraded for the privacy of the user.

It is intended that this logging of the user's position should be a transparent process where users can see the history and resolution of stored information and delete the log if they desire. Users' locational trends are extracted to preserve positional information whilst deleting the data itself. A number of techniques are proposed to achieve this aim including generalised templates of regularly repeated routes and spatio-temporal envelopes. In addition this component aims to make assumptions about user activity and potential future locations from their recent history.

4 Information Filtering and Delivery

4.1 Information Filtering Needs

With the rapid progress of computer technology in recent years, electronic information has been explosively increased. This trend is especially remarkable on the Web. As the availability of the information increases, the need for finding more relevant information is growing. However, since Web-index services are based on general purpose indexing methods, much of the retrieved results may be irrelevant to user's interests. Seo and Zhang [7] point out that a high quality service requires catching the personal interests of individual users during the interaction with the information retrieval system. These information-filtering systems have recently gained

popularity, mainly as part of various information services based on the Internet. Information filtering systems are similar to conventional information retrieval systems in that they aid in selecting documents that satisfy users' information needs. However, certain fundamental differences between information-filtering and information retrieval systems exist and are in a detail described e.g. in [1].

Information filtering systems are commonly personalised to support long-term information needs of a particular user or a group of users with similar needs. They accomplish the goal of personalization by directly or indirectly acquiring information from the user. In information filtering systems, these long-term information needs are represented as user interest profiles, which are subsequently used for matching or ranking purposes. The user interest profiles are maintained beyond a single session and may be modified based on users' feedback. While information retrieval systems usually operate on a relatively static set of documents, information-filtering systems are usually concerned with identifying relevant documents from a continuously changing document stream.

4.2 Active Information Delivery

Apart from the generally known push technology drawbacks, the push technology seems to be useful and usable for above-mentioned information filtering systems. Nevertheless, only a minority of end users wish to be unceasingly interrupted by the delivery of newer and newer information, majority of which could be useless thanks to rather complicated way of the user profile creation using, say, a complicated and boring questionnaire. We have already proposed [5] a solution called active semi-push information delivery, which requires more activity from the user's computer, based on increased intelligence of the push client running on the computer. Such push client with "increased intelligence" should be able:

- To learn intelligently and automatically about the user's intentions, aims, and activities.
- To adapt the level of its communication with the human user according to the user's skills as well as to her/his activities, or tasks recently performed. It means, that what is appropriate in a communication with a novice, might not be suitable for an expert. On the other hand, when looking for a urgent doctor's help, user usually need not be informed about recent NHL results immediately via an unscheduled yet subscribed push service.
- To adapt the content of delivered information or knowledge to the contents of recently requested/delivered information or knowledge. This means to be able to volunteer more than standard contents, e.g. additional relevant information or knowledge, which could interest the user or be of a further help relative to the recent task solved by the user. It needs, of course, to know more about the user's recent tasks, and to have an access to expert knowledge helping to perform the tasks successfully.

The idea of using the active semi-push information delivery has the following essential points:

- It is based on the so-called "smart-pull" technology, where user's computer (client) seeks for new information automatically, on the basis of a predefined schedule.
- The client has an active component based on a combination of learning software agents with a knowledge-based system co-operating with a kind of intelligent user interface. It means that the client is able to increase the level of its knowledge about the user (using a frame-based user modelling technique) and is volunteering the information/knowledge only if it is adequate and not disturbing. Moreover, the form how the information is offered will be more adequate to the user's niveau.

5 Conclusion

The Hypergeo project described in our paper is a good example of a new trend in tourism information support – a wireless on-line information system, addressing mobile users of portable devices like PDA's or advanced mobile phones. A couple of similar projects appeared recently, see e.g. [2]. These interesting and useful projects seem to be a good vehicle for developing and experimenting with a couple of new, challenging technologies, like those described above. We are deeply convinced that the results of this kind of projects will be employed by the everyday practice very soon.

References:

[1] Belkin, N. J., Croft, W. B.: Information filtering and information retrieval: two sides of the same coin?, *Communications of the ACM*, Vol. 35, No. 12, 1992, pp. 29-38.

[2] Davies, N., K. Cheverst, et al.: Caches in the Air: Disseminating Tourist Information in the Guide System. In: *Second IEEE Workshop on Mobile Computer Systems and Applications*, New Orleans, Louisiana, 1999

[3] Hynek, J.: Classification using genetic programming. In: *6th International Conference on Soft Computing MENDEL'2000*. University of Technology, Brno, 2000, pp. 71-75.

[4] HYPERGEO Project Home Page, available on the URL: http://www.hypergeo.org

[5] Mikulecký, P., Mikulecká, J.: Active Tools for Better Knowledge Dissemination. In: *ASIS 1999 Annual Conference (L. Woods, ed.)*, Washington D.C., Printed for ASIS by the Information Today, Inc., Medford, NJ., 1999, pp. 420-427.

[6] Mountain, D.M., Raper, J.F.: Designing geolocation services for next generation mobile phone systems. In: *AGI 2000 Conference at the GIS 2000, Workshop 2: Technology Updates*, Part 2.4, 2000, pp. 1-8.

[7] Seo, Y.W., Zhang, B.-T.: A Reinforcement Learning Agent for Personalized Information Filtering. In: *Intelligent User Interfaces - IUI 2000*, New Orleans, 2000, pp. 248 – 251.

[8] Singhal, A. et al.: Learning Routing Queries in a Query Zone. In: *ACM SIGIR 97 Conference*, Philadelphia, 1997, pp. 25-32.