Multi-Agent Mobile Tourism System

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INTRODUCTION

Nowadays, with the emergence of high-speed wireless networks, various portable devices such as personal digital assistant (PDAs), mobile phones, and other wearable equipment are widely used by people in their daily lives. Context-awareness plays a vital role in enabling smart environments, wearable computing, and wireless computing. This article presents the multi-agent system, which uses mobile technology to offer services in the tourism domain.

Agent-based systems are widely used for mobile and distributed information systems. Agents can also help in preventing the user from being overwhelmed by irrelevant information using personalization methods. This technology provides the integration of information from diverse sources, while personalization provides the filtering technique to deliver the relevant information to the users.

The system gives up-to-date information based on the user's preferences and other contextual information such as sight location, weather condition, and special functions that are arranged during the visit. The system consists of two types: Web-based and mobile-based. We design the system as client-server architecture, supporting desktop clients as well as mobile clients on a handheld device with appropriate interfaces. However, in this article, we now focus on the mobile-based tourism system. The handheld device or PDA is used for receiving information from a Web server.

In past years a broad spectrum of different Web-based tourism has been established. The acceptance and consequently the competitiveness of a tourism system are mainly determined by the quantity and quality of data it provides. Therefore, most existing tourism systems try to fulfill the tourist's request (interest) for an extensive data collection (Rumetshofer & Wob, 2005).

Tourism information (e.g., travel schedules, etc.) are distributed, dynamic, and heterogeneous. The users (tourists) may face difficulty using them when planning their trips.

Nowadays, the improvements in wireless communication technologies such as handheld devices to the Internet open up new prospects for e-commerce and e-tourism. Today, new technologies allow more flexible access to information booking services and other tourist support (Belz, Nick, Poslad, & Zipf, 2002). Tourism has been a popular area for mobile information systems. There are a number of obstacles to introducing new technology in tourism. Electronic guidebooks and maps have been a popular application area for mobile technology.

In the near future, a broader range of services will become available to users anywhere, at any time. People can receive their required information by interacting with their PDA from wherever they are. Kanellopoulos and Kotsiantis (2006) stated that the tourism industry makes efforts to implement techniques that can reduce travel cost and improve performance.

A major issue in offering mobile services to nomadic users is the limited display and networking capacity of mobile devices such as wireless application protocol (WAP) phones or PDAs. A possible solution for this is the adaptation of services and contents to the users' personal interests and their current location. The adaptation of services and contents to personal interests mainly filter the available information. Poslad et al. (2001) described the filtering process as based on a user profile describing the interests, abilities, and characteristics of the user.

Ding, Malaka, and Pfisterer (2002) described multi-agent systems as particularly well suited for mobile information systems, and some systems even allow for resource-aware computations in mobile and distributed environments.

Maw and Naing (2006) described the architecture and design of a multi-agent tourism system (MATS). MATS evaluated the similarity value and mean absolute error (MAE) to give the best recommendation to the user.

The central motivation of this article is to extend MATS suitable for the mobile user in the tourism domain. The objective is to give the user the most relevant and updated information according to the user's interest.

The next section provides the definitions and a discussion of the system, and reviews literature of some related works. The main focus of the multi-agent mobile tourism system architecture is then described, and the design considerations and future trends are also discussed, before we conclude the article.

BACKGROUND

In this section, we provide definitions and review some related works. There are a number of research projects related to the tourism system. The multi-agent system, personalization methods, and mobile technology are discussed in the literature.

Wooldridge (2000) defined multi-agent system as a collection of agents that work in conjunction with each other. In multi-agent system architecture, each agent is autonomous, cooperative, coordinated, intelligent, and able to communicate with other agents to fulfill the user's requirements.

The characteristic of agent proactiveness can provide the user with information related to his or her profile. Agents are autonomous, so they act on behalf of a user to reach a goal or solve a problem for the user. Agents filter information that is suitable for the user on the basis of a user profile that stores the user's interests. Agents need an agent platform, which provides communication for the agents, other services, and security features.

There are many advantages in the mobile devices of agent technology, such as providing services to the user in a personalized way.

Personalization means knowing who the user is, what the user's interests are, and recognizing a specific user based on a user profile. Willy (2001) and Rumetshofer and Wob (2005) defined personalization as a process of gathering and storing information about users, analyzing the information, and based on the analysis, delivering the information to each user at the right time.

Personalization is also an important feature of mobile services. Personalization adapts the services to the user location, user preferences, and user profile.

Poslad et al. (2001) described that "Creation of User-friendly Mobile services Personalized for Tourism" (CRUMPET) is a mobile application that uses multi-agent technology to construct a context-aware system. The system combines personalized services, multi-agent technology, location-aware services, and transparent mobile data communication, altogether in order to facilitate the users. The services provided by CRUMPET take advantage of integrating four key emerging technology domains and applying them to the tourist domain: location-aware services, personalized user interaction, seamlessly accessible multimedia mobile communication, and smart component-based middleware that uses multi-agent technology. Its use is mainly limited to providing query and recommendation services.

The GUIDE project (Simcock, Hillenbrand, & Thomas, 2003, Cheverst, Mitchell, Friday, & Davies, 2000) studies the electronic tourist guide system of Lancaster City. It obtains the user position by receiving location messages transmitted from non-overlapping WaveLAND cell base stations dispersed throughout the city. Wireless communication was used via a pen-based tablet computer. While this approach does not need additional hardware on the client side, it results in a lower resolution of positioning information.

The Cyberguide project (Abowd et al., 1997) is a handheld electronic tourist guide system that supplies the user with context-sensitive information. It was built in the mid-1990s, and its goal was to provide the information to a user based on the user's position and orientation. The application is hosted entirely on an Apple MessagePad and used infrared beacons for positioning using a Trimble GPS unit.

Hinze and Buchanan (2006) described the tourist information provider (TIP) as a mobile tourist information system that presents information to the user that is sensitive to the user's context, interest, and the related context of neighboring sights of interest. TIP provides map-based and browser-based information navigation, and uses contextual hierarchy to support outliner-style browsing that is efficient on small-screen, mobile displays (Hinze & Buchanan, 2005). The user dynamically interacts with the system by providing his or her current location while asking for information from the system. TIP also gives recommendation to users based on their current position and the information in their user profiles. They get a list of nearby sights which they might like to visit if they request the system's recommendation.

The IMAGE system proposed e-services for mobile users and introduced the personalized service feature, using agent technology in the context of the IST project IMAGE. In the IMAGE system all roles are implemented as agent types with the exception of the social role, which is realized by all agents that need to be acquainted with their collaborative partners. Their system integrated a set of intelligent agents having different functionalities (e.g., personalized assistance, travel information, and cultural events information), which are necessary in order to cover the needs presented by this specific application field called mobile personalized location-based services.

We also provide the services for mobile users by using personalized services with agent technology. The system uses GPS data to recognize the user location. The system gives the recommendation to the user according to the location of the user and user preferences.

MULTI-AGENT MOBILE SYSTEM ARCHITECTURE

A mobile system can be deployed in a wide range of physical environments to support users in diverse tasks. Advanced mobile systems need to exploit information about the environment in which they are working.

In this article, we extend our previous MATS to a mobile system. Figure 1 shows the general architecture of a multi-agent mobile system. A more detailed description is provided in Maw and Naing (2006).