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Traveler-Oriented Advanced Traveler Information System based on Dynamic Discovery of Resources: Potentials and Challenges

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Abstract

An Advanced Traveler Information System (ATIS) aims at providing travelers with multi-modal trip planning, route guidance services and advisory functions. Most ATIS's provide travel solutions that cover only specific geographic areas, travel modes and/or transport operators, and are insufficiently personalized. Moreover, the solutions are normally constructed upon a fixed set of resources (e.g. data sources and services), and thus are not highly adaptable to travelers' diverse needs. Considering numerous existing ATIS's and other resources on the Web, our vision is to use them complementarily to improve the adaptability, completeness, and personalization of the solutions. We envision an ATIS design, called traveler-oriented ATIS, that discovers and exploits web resources in an integrated manner to construct travel solutions tailored to travelers' needs. In this paper, we discuss common approaches to managing resources, upon which the solutions are built, employed in various ATIS's and their limitations that lead to our vision. Challenges of the vision are investigated, and a possible approach to address them is presented along with potential applications of Semantic Web and Multi-Agent Systems in the approach to demonstrate a promising direction to concretize the traveler-oriented ATIS design.

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Keywords: Advanced Traveler Information System; Traveler-Oriented; Multi-Agent Systems; Semantic Web

1. Introduction

Efforts have been invested to use information and communication technologies to develop Intelligent Transport Systems (ITS) whose aim is to support transportation of goods and humans in order to safely and efficiently use transportation means and infrastructure (ETSI (2011)). As an integral part of ITS, Advanced Traveler Information System (ATIS) assists travelers with planning, perception, analysis and decision-making to improve convenience, safety and efficiency of travel (Dong et al. (2010)). In contemporary society where travel plays an important role in our daily lives, ATIS's can be very essential. In fact, traveling with personal vehicle and/or public transportation can be complicated and stressful, especially to unfamiliar destinations. In case of using public transportation, choosing an optimized itinerary requires knowledge about public transportation network and services. Similarly, traveling

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on private vehicles necessitates familiarity with roadways and road conditions. On top of these, multi-modal trips, which involve multiple travel modes (e.g. plane, train, taxi) and highly probably various transport operators, are even more demanding. Through ATIS's, the provision of useful travel information and assistances to travelers could lead to diminishing stress related to trip planning and navigating, more efficient trip choices, reducing travel time (Adler and Blue (1998)), and avoiding congestion as well as dangerous driving conditions (Kumar et al. (2003)). For instance, information about road conditions and accidents provided by ATIS's allows travelers to make an informed route decision, more precisely, taking cautions or avoiding dangerous routes and choosing a safer path. Moreover, optimized trip plans enable travelers to arrive at their destinations faster as well as reduce energy consumption.

Currently, numerous ATIS's are in operation. However, most, if not all, ATIS's were designed to target only certain types of travelers, travel modes, transportation services provided by certain operators, and/or geographical coverage. Therefore, regardless of the significant number of existing ATIS's, travelers are quite often still required to consult multiple ATIS's and/or to seek for travel information from various sources to acquire enough information and assistances for their trips. In addition, when there are changes or unexpected events (e.g. delays or accidents) during the trips, travelers need to rebuild their itinerary to adapt to those changes. Travelers are also expected to have knowledge of transportation networks and services to perform such tasks. Moreover, most ATIS's build travel solutions based on a fixed set of resources (e.g. data sources, collected data, services), and hardly any, or possibly none, discover and use resources that are relevant to specific requests, constraints and preferences of travelers. Hence, the solutions provided might not be able to meet each traveler's specific needs, considering their variety. Furthermore, only a small number of ATIS's take travelers' preferences into account and provide personalized services and information to travelers.

Let us consider a scenario where a person named James wants to visit Paris for the weekend. James lives in a French commune called Saint-Just-Saint-Rambert. Wanting to find a fast and cheap transportation, James plans his trip by searching for cheap flights to Paris via several websites. Then, to explore other options, he consults the websites of SNCF, Megabus and BlaBlaCar for itineraries by train, bus and carpooling, respectively. Having compared those options, he decides to go by train because it costs a lot less than the flights, and the travel time difference is fairly small. Since there are no train stations in his commune, James has to travel using a local bus to the train station in the nearby city, Saint-Étienne. Hence, he needs to also consult the website of that local bus. With all the information he has collected, James chooses the departure time for each segment of his trip, and builds a complete itinerary for his trip to Paris. At this point, everything seems well, and James is prepared for his trip. However, when he is walking to the bus station, it starts to rain. James does not have his umbrella because the website of the local bus did not provide him the weather information along with the itinerary. When he reaches the bus station, there is an unexpected accident, about which he was not informed, so he will not be able to catch his train. Therefore, he needs to search for the next train. Unfortunately, it costs a lot more than his intended train, so he checks various websites again for a cheaper trip. Eventually, he found a train with the same price, but it leaves in 3 hours. With a lot of patience, finally, he arrives in Paris. James searches for rental cars. Then, to find parking lots, James has to consult yet several other parking applications. This scenario illustrates that the traveler has to make a lot of efforts to consult multiple ATIS's and to collect information from various sources to build an itinerary respecting his preferences and constraints. In addition, when there are changes or unexpected events during the trip, the traveler needs to rebuild his itinerary to adapt to those changes. Any missing information, in this case weather and accident, can disrupt the itinerary or render it pointless.

Thus, the aim of the traveler-oriented ATIS is to automatize the entire process of searching for relevant and useful resources (e.g. existing ATIS's, information sources, services) available on the Web, accessing them, and combining acquired information and services to build travel solutions tailored to each traveler's requests and needs. Presently, massive availability of data and services, resulted from continuous expansion and uses of the Internet and the Web, opens a perspective toward the design of an ATIS that exploits a large, dynamic, and open set of data sources and services. Coupled with the advancement in the fields of Artificial Intelligence, namely Semantic Web (SW) and Multi-Agent Systems (MAS), this design presents a promising solution to build the traveler-oriented ATIS.

The rest of this paper is organized as follows. Section 2 provides some background information on functionalities and variations of ATIS's. Section 3 discusses common approaches to acquiring data and services employed in various ATIS's. Section 4 presents our vision of the traveler-oriented ATIS and its challenges. The approach to address the challenges and potential applications of SW and MAS in the approach are described in Section 5. Section 6 concludes the paper.