A Prototype of Smart Navigation Service

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***Abstract*—Travelers may arrange tourist destinations, plan a travel route, book a hotel accommodation, and reserve a restaurant through different online services. However, the scattering of the above travel information hinders the efficient browse, search, and usage during the trip. Besides, the travel information is not leveraged well for timely and personalized assistance. In this work, a smart navigation service is proposed to provide efficient navigation for travelers. Based on travel planning and travel context of travelers, the smart navigation service can identify the purpose of travelers, and provide corresponding navigation through the information retrieved from transportation or news services proactively.**

Keywords–Navigation; travel navigation; cloud computing.

I. INTRODUCTION

Before a trip, travelers may arrange tourist destinations, plan a travel route, book a hotel accommodation, and reserve a restaurant through different online services [1]. During the trip, travelers can use smart devices to search for corresponding travel information preserved in different services [2]. For instance, travelers can log into online booking service (e.g., Booking.com [3], Agoda [4], Trivago [5], and so on) to retrieve the information of hotel accommodation, and then use navigation services to find the way to the hotel. Travelers can also log in to mail service to retrieve the message of transport ticket, find the way to the station, locate the correct platform, and take the corresponding vehicle to the tourist destinations. Moreover, travel planning preserved in the online calendar (e.g., Google Calendar) or note applications (e.g., Evernote [6], OneNote [7], and Google Keep [8]) provides navigation reference for travelers during the trip. However, it can be found that travelers need to manually perform several tasks through different services to achieve their purpose in the trip. Major obstacles are stated as follows.

- **The scattering of travel information:** One obstacle is that information associated with the trip could exist in several services, including online calendar, note applications, booking services, and mail services. Travelers need to browse and search for corresponding travel information from different services during the trip. The scattering of travel information hinders timely and efficient assistance to travelers [9][10].
- **The lack of personalized guidance:** The other obstacle is the lack of personalized guidance for travelers according to their travel plans. Based on the information (e.g., destination, transportation, reservation, and so on) preserved in the travel plan and the travel context of travelers (e.g., date, time, and location), corresponding navigation could be identified and provided proactively [11].

To overcome the obstacles identified above, a smart navigation service is proposed to provide timely and personalized navigation for travelers. The smart navigation service acquires travel information from different services under the authorization of travelers and derives a comprehensive travel plan. During the trip, the smart navigation service collects travel context of travelers from smart devices continuously, and identifies the purpose of travelers based on the identified travel plan. In addition, the smart navigation service collects information about transportation or emergency events continuously. According to the identified purpose of travelers and the collected transportation or emergency information, corresponding navigation can be provided for travelers proactively.

In the remainder of this work, Section 2 introduces the architecture of the smart navigation service. Section 3 describes an use case of the prototype of the smart navigation service. Finally, conclusion and future directions are given in Section 4.

II. ARCHITECTURE

The overview of the smart navigation service is shown in Figure 1. Major components in the smart navigation service are stated as follows.

- **Smart devices:** The smart devices carried or wore by travelers acquire travel context (e.g., date, time, and location) and transmit the information to the travel navigation cloud continuously. The travel context will be used by the travel navigation cloud for identifying the travel status and purpose of travelers. Based on the purpose of travelers, the corresponding navigation can be displayed by the smart devices [12]. In the near future, augmented reality navigation can also be employed to achieve better assistance to travelers [13][14].
- **Travel navigation cloud:** The travel navigation cloud is responsible for three major functionalities in the smart navigation service. The first functionality of the travel navigation cloud is to construct a comprehensive travel plan based on the information preserved in different online services. Important information during a trip, including destination, transportation, accommodation, itinerary, restaurant, associated date and time, can be retrieved through Application Programming Interfaces (APIs) of different online services. The information can be further identified and recognized by

 ISBN: 978-1-61208-827-3

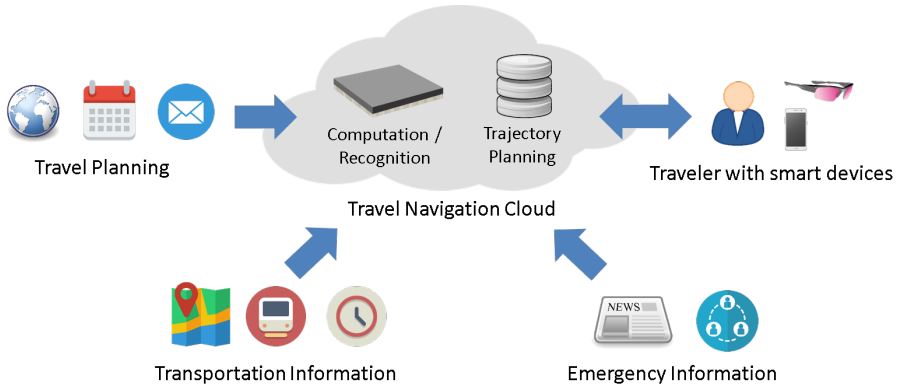

Figure 1. Overview of the smart navigation service.

natural language processing and named-entity recognition methods [15][16]. The second functionality of the travel navigation cloud is to collect current travel context (e.g., date, time, and location) of travelers through smart devices and identify the purpose of travelers based on the derived travel plan. The final functionality of the travel navigation cloud is to collect information from transportation services and news services continuously. Similarly, the collected information can be further identified and recognized by natural language processing and named-entity recognition methods. Based on the information recognized in the travel plan and the travel context of travelers, corresponding navigation according to the information provided by transportation services and news services could be identified and provided proactively.

- **Travel planning:** Travelers can arrange their travel plans through various online services nowadays. For instance, hotel accommodation can be reserved through online booking services. Transportation tickets can also be purchased online. In addition to the information preserved in different online services, corresponding reservation information might be provided for travelers through emails. Travelers can also use online calendar or note applications to manage their tourist destinations and associated itineraries. Thus, a travel plan can be extracted and identified from the above travel information existed in different services. Under the authorization of travelers, the travel navigation cloud acquires, analyzes, and identifies a comprehensive travel plan of travelers for proactive navigation during the trip.
- **Transportation information:** During a trip, travel from one place to another is one of the most important activities. However, travelers might need to forage for travel information scattered across different online services and make a right decision based on several transmit choices. The provision of personalized transportation information (e.g., timetable, route, vehicle status, travel time, and fare) will be highly beneficial to travelers [17]. Thus, detailed information of airport, rail service, ferry service, bus, and so on will be retrieved by the travel navigation cloud through APIs provided by service providers or government open data [18]. Based on the derived travel plan, identified travel context, and the transportation, proactive navigation can be provided for travelers for better travel experience.
- **Emergency information:** During a trip, emergency situations (e.g, disaster, traffic accident, strike, and so on) might happen and have influences on travelers. The travel navigation cloud retrieves news from different news services or social networks [19]. The location, occurrence time, and impact of specific emergency situations can be extracted by natural language processing and named-entity recognition methods. Based on the transportation information and the emergency information, the travel navigation cloud can identify and provide alternative travel choices for travelers to avoid emergency situations.

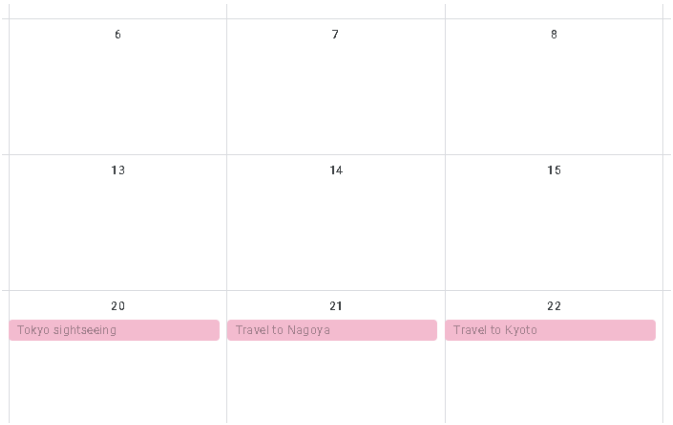

Figure 2. Travel plan in the online calendar.

III. USE CASE

One use case is described to demonstrate the usage of the smart navigation service. As shown in Figure 2, a traveler arranges a list of cities (i.e., Tokyo, Nagoya, and Kyoto) on a journey and puts the information in the online calendar. On a specific day during the trip, the traveler arrives at the train station of the city (i.e., Tokyo). Through the travel context acquired by the smart device and the travel plan (destination city) retrieved from the online calendar, the travel navigation

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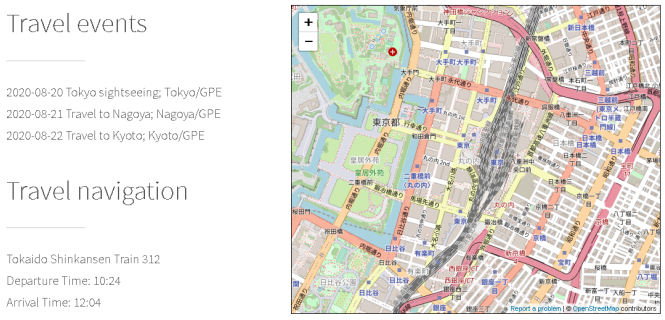

Figure 3. Travel navigation for travelers.

cloud identifies the current travel status and the purpose of the traveler (i.e., travel to Nagoya). As shown in Figure 3, based on the identified purpose of the traveler and the transportation information retrieved from the government open data, train number, departure time, and arrival time of the appropriate train can be identified and provided by the smart navigation service. Thus, without manual operation, the traveler can get timely and personalized travel guidance efficiently. Better travel experience can be achieved.

IV. Conclusion and Future Work

A smart navigation service is proposed in this work to provide timely and personalized navigation for travelers. Based on travel planning and current travel context of travelers, the smart navigation service can identify the purpose of travelers, and provide corresponding navigation through the information retrieved from transportation services or news services proactively. The design of the smart navigation service is introduced, and the current prototype is demonstrated through a use case. Future work includes the integration of more online services, transportation services, and news services for comprehensive navigation for travelers.

Acknowledgment

This study is supported by the Ministry of Science and Technology of the Republic of China under grant MOST 108-2221-E-143-003-MY3.

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 ISBN: 978-1-61208-827-3