

Integrating Personalized and Community Services for Mobile Travel Planning and Management

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Abstract. Personalized and community services have been noted as keys to enhance and facilitate e-tourism as well as mobile applications. This paper aims at proposing an integrated service framework for combining personalized and community functions to support mobile travel planning and management. Major mobile tourism related planning and decision support functions specified include personalized profile management, information search and notification, evaluation and recommendation, do-it-yourself planning and design, community and collaboration management, auction and negotiation, transaction and payment, as well as trip tracking and quality control. A system implementation process with an example prototype is also presented for illustrating the feasibility and effectiveness of the proposed system framework, process model, and development methodology.

Keywords: Personalized services, community services, mobile services, travel planning, integrated service framework.

1 Introduction

Personalized services refer to information, communication, transaction, or decision support services that are tailored to meet customers' needs and preferences [1]. Community services, on the other hand, provide functions for customers to form special interest groups, locate people with similar interests, set up community forum and collaborative platform, as well as share information and experiences [6,24]. The rapid advancement of mobile technologies has stimulated the demands for more personalized and community based mobile services in a wide range of application domains such as tourism, healthcare, learning, and government [6,8,10,12,22,24]. In general, mobile services refer to information, communication, and transaction services that are accessed and delivered via mobile communications networks. Customer values identified for mobile services include ubiquitous access, convenience, personalization, localization, productivity enabler, time saving, better tracking, cost reduction, security enhancement, as well as lower prices and special promotions [2,26]. Specifically for the tourism application domain, mobile technologies have been pointed out as one of the most promising innovative technologies for promoting and enhancing the quality of tourism related services, as well as for creating tourists' values [3,6]. Tourists or travelers are typical on-the-move customers that need services with mobility and

ubiquity features. They like to get help in designing, operating, adjusting, and re-recording personalized travel plans that take into account their needs and preferences in all pre-trip, during the trip and post trip phases [11,29,32]. They also like to seek and share information and experiences with other people of similar tourism interests, get recommendations from community members based on their past travel cases and ratings, and possibly form a tour group and plan their joint trips through social interaction and collaboration [6,9,24].

As a key service in tourism application, tourism and travel planning is a process of searching, selecting, grouping and sequencing destination related products and services including attractions, accommodations, restaurants, and activities [4,5,7,11,17,18,25,27,32]. As more functional support on ubiquitous accessibility, tourism information availability, and community interactivity emerged, the requirements of more personalization, localization, and collaboration services for mobile tourism related planning and transactions increase significantly [4,11,32]. As a result, how to provide and integrate personalized and community services for enhancing and facilitating travel planning and management have become critical issues in tourism related research and practices. However, little progress has been made in this area to improve the performance and management of travel planning processes. Existing commercial mobile services and research works regarding personalized and community based travel planning services are still very limited and primitive. There is still a lack of integrated service framework and design process for guiding the development of personalized and community enabled travel planning services to meet the travelers' needs and preferences. For filling the research gap, this paper aims at proposing an integrated service framework for combining personalized and community functions to support user-centric mobile travel planning and management. Also presented include related system design methods and an example prototype to illustrate the feasibility and effectiveness of the proposed integrated service framework, application process, and system development approach. The rest of this paper is organized as follows. A comprehensive literature review on personalized and community services in mobile tourism applications is provided in section 2. In section 3, the integrated service framework for supporting personalized and community based mobile travel planning and management is presented. Section 4 contains the illustration of a system development process with a prototype. A concluding remark with future research issues are given in the final section.

2 Literature Review

In the following subsections, previous research works related to personalized services as well as community and collaborative services in mobile and tourism application domains, separately and jointly, are reviewed and discussed.

2.1 Personalized Services in Mobile and Tourism Application Domains

In the literature of web-based personalization, major types of personalized services in various application domains include the directory and search services, the selection and recommendation services, the self-planning and customization services, as well as

the auction and negotiation services. In mobile applications, personalized services often take users' location and time as part of the conditions for information search and recommendation [8,12]. As for the tourism application domain, previous research have also circled strong demands of information-intensive and decision-support services that incorporate personalized needs and preferences in all tourism-related searching, decision making, and transaction processes [19,25,29]. For instances, Ricci et al. (2002) present a case-based reasoning (CBR) approach to be adopted in travel recommender systems for assisting users in travel-related information filtering and product bundling [19]. Tomai et al (2005) explore how to use ontologies for assisting tourists in trip planning in a web-based environment by illustrating the building and matching of the users profile and tourism information ontologies [25].

Focusing on issues and methodologies for developing personalized mobile tourism applications, Scherp and Boll (2004) present an approach and example of dynamically generating personalized multimedia content for generic tourist guide based on the tourist's interests and preferences, current location and environment, and mobile device used [25]. Breunig and Baer (2004) collect requirements and present an implementation prototype of a mobile route planning system that is capable of supporting spatial database queries [4]. Adopting multi-agent and semantic web technologies with aims to effectively coordinate and integrate disparate information and service resources anytime and anywhere, Chiu and Leung (2005) propose a ubiquitous tourist assistance system for providing personalized assistances to tourists by taking into account their different preferences and often changing during-he-rip requirements [9]. By presenting location-based applications based on the combination of Global Navigation Satellite System (GNSS) and Geographical Information System, Sadoun and Al-Bayari (2007) show the potential of using positioning techniques for improving location determination, geo-location information navigation, vehicle tracking and route planning services. [21]. For supporting dynamic and context-based trail management, Driver and Clarke (2008) propose an application framework that comprises trail generation and trail reconfiguration point identification modules for effectively managing mobile and context-aware trails [11]. Castillo et al. (2008), to provide supports for planning tourist visits in a city, present an user-oriented adaptive system that is intended to work in portable devices with internet connection and is functionally capable of accessing ontology-based information, capturing and updating a user model about different city visits, selecting a list of interesting places to visit through a case-based reasoning approach, as well as generating a schedule plan by taking into account goals, preferences, places, distances, timetables, and transportation means [7]. To facilitate the design of a personalized route planning system, Niaraki and Kim (2009) present a generic ontology-based architecture using an analytic hierarchical process (AHP) to determine an appropriate impedance model of road segments based on user preferences [18]. Through presenting a prototype developed on the top of Java 2 Micro Edition (J2ME), Kenteris et al. (2009) highlight main advantages and shortcomings in implementing a mobile tourist guide application that enables the automated creation of portable, personalized tourist applications with rich and customized content while minimizes the wireless connectivity requirement of the mobile users [15]. To efficiently and effectively provide various mobile recommendations regarding sightseeing spots, hotels, restaurants, and packaged tour plans, Yu and Chang (2009) propose a system architecture and design methods for facilitating the delivery

of location-based recommendation services to support personalized tour planning based on tourists' current location and time, preferences and needs, as well as constraints and selection criteria [32].

2.2 Community Services in Mobile and Tourism Application Domains

In research addressing community and collaborative services, major service types mentioned include profile management, resource management, community management, conflict management, search and notification, activity and event arrangement, group communications and messaging, as well as meeting and conferencing [6,10,16,24,28,30,31]. For research involving the mobile application environment, features and issues such as mobility, ubiquity, and localization are emphasized and addressed for conveniently activating community and collaborative services independent of location, time, and connectivity constraints [10,16,24]. As examples, in a three layered service architecture for supporting mobile teamwork, Kirda et al. (2002) organize access control, user management, community management, artifact management, repository, messaging, subscription, and distributed search as components of the teamwork services [16]. Addressing the need of mobile share workspaces for ubiquitous collaboration, Divitini et al. (2004) present an experimental collaboration service platform in which services offered enable users to create and maintain profiles of users, activities, and resources, to dynamically configure these entities, and to maintain the presence model [10]. Describing the community platform as an innovative value added service system for supporting mobile coordination of individuals, Schubert and Hampe (2006) present a group of value services to community members of the leisure industry that include searching personalized information specials, seeking leisure partners, and coordinative arrangement of leisure events [24].

As for research in the community-enabled electronic and mobile tourism domain, only initial studies have been delivered [6,28,30]. Wang et al. (2002) define virtual tourist community and discuss its implications for tourism marketing [28]. By conducting an empirical study on members of online travel communities, Wu and Chang (2005) report findings about how interactivity and trust affect the experience of flow and how flow affects transaction intensions of these members [30]. While targeting on mobile applications, Carlsson et al. (2008) present a mobile community based service that incorporates three key elements, namely online tourist communities, mobile blogging, and mobile social networks to facilitate information search and experience sharing through social interactions among tourists co-located at a given destination [6].

From the above literature review, it can be seen that although personalized services, community services, mobile services, and tourism services have been noted as strongly related fields for research and practices, very few have provided integrative views and frameworks that incorporate the featuring concepts and methodologies to facilitate hybrid personalized and community services for mobile tourism applications, especially for mobile travel planning. Among these rare works, Yu (2005) propose a functional framework and design process for building customer-oriented decision support systems to jointly deliver personalized and community tourism services [31]. Major decision support functions include personalized data and model management, information search and navigation, product/vendor evaluation

and recommendation, do-it-yourself travel planning and design, community and collaboration management, auction and negotiation, as well as trip tracking and quality control. However, only a limited scope of mobility features has been discussed. On the other hand, focusing on designing location based tourism services, Kansa and Wilde (2008) point out that the central requirements for empowering tourists to filter and augment their travel experiences, and to co-create and engage generated content and experiences with peers include ubiquitous recommendation, augmentation of travel realities, as well as peer production of tourist realities [14]. Nevertheless, decision functions regarding community and collaboration support for travel planning have not been fully explored. In summary, previous research regarding personalized services and/or collaborative services in mobile tourism applications usually dealt with problems of limited scopes and focused only on specific functions and/or techniques. The needs of an integrated architecture and design process to incorporate personalized and community services for supporting mobile individual as well as coordinated group travel planning are significant.

3 The Integrated Service Framework and Process Model

Through an ideal integrated personalized and community-based mobile travel planning support system, users should be able to create and maintain personal profiles, to search location and context aware information, to view geo-information and maps with GIS support, to share information, experiences, and resources with community members, to receive information and recommendations about point-of-interests and tour plans based on their needs, preferences, and conditions, as well as on experiences and ratings of other users with similar conditions and interests, to plan a personalized trip schedule, to seek travel partners and to collaboratively plan a group travel plan, to search and select tourism operators based on auction and negotiation, to track during-the-trip positions and conditions for assuring safety and quality of the travel plan, to rate point-of-interests and travel plans, as well as to store post-trip travel plans as cases for future references. To develop such a powerful personalized and community-based mobile tourism support system for travel planning and management, major information management and decision support functions to be specified in the application level include mobile personalized profile management, mobile information search and notification, mobile evaluation and recommendation, mobile do-it-yourself planning and design, mobile community and collaboration management, mobile auction and negotiation, mobile transaction and payment, as well as mobile trip tracking and quality control. Both the specific point-of-interests and travel plan that bundles attractions, activities, durations and distances with sequential orders can be acquired using the location-based and context-aware personalized recommendation services with map-based positioning and visualization facilities. Functional requirements of the back end system level include data base, model base, and knowledge base management, as well as ontology and case base management. Descriptions of the integrated service framework and process model for guiding the development and operation of the ideal system are provided below.

3.1 The Integrated Service Framework

The integrated service framework of personalized and community-based mobile travel planning and management support system is shown in Figure 1. Specifications of associated service functions are as follows.

Mobile Personalized Profile Management: Functions in this group enable users to create and maintain their personal profiles including basic personal information and personalized travel preferences, previous visits to cities and places of interest such as sightseeing spots, restaurants, and hotels with satisfactory ratings, as well as past implemented travel plans with ratings. Users can also specify their personalized evaluation criteria for selecting tourism-related products, services, agents, operators, or tour plans. Also included are facilities for users to sign up to specific community groups, to create and manage personalized link lists of frequently accessed tourism sites or favorite points of interest, as well as to record and maintain their travel histories by using blogs, photo albums, and other textual/multimedia documents.

Mobile Information Search and Notification: These functions allow users to search, retrieve, navigate and browse requested tourism information such as destinations and events, weather and traffic conditions, airline or train schedules, nearby restaurants or shopping centers, hotels with available rooms, travel agencies and group packaged tours, as well as travel experiences and resources of other community users, etc. Users can also receive notification and relevant information such as airplane boarding time or hotel check in/check out time, promotion or other special events in nearby shopping malls, etc in a pushed manner.

Mobile Evaluation and Recommendation: These grouped functions support users for specifying their needs, preferences and criteria, as well as current location, time and constraints, and then for activating the evaluation process to generate system recommended tourism products, services, points of interest, or package tours that closely match users' needs and preferences. Users' needs, preferences and evaluation criteria can be specified by accessing data from the user profiles or by directly inputting data as specific instances. Intelligent decision support functions with rule sets and decision models are used for recommending travel agencies' matched package tours, while case-based reasoning is used to recommend community members' similar travel cases.

Mobile Do-It-Yourself Planning and Design: Main functions of this service group provide a simple interface to allow users interactively specifying cities, attractions, restaurants and hotels in a sequential date basis to design and form personalized travel plans. Users can start the DIY process from scratch by picking, bundling, and sequencing chosen cities, sightseeing spots, restaurants and hotels in a daily basis, or from a retrieved case of implemented travel plan with similar features.

Mobile Community and Collaboration Management: Using the basic community services, users are capable of locating members of similar travel interests, forming special tourism interest groups, setting up tourism-related community forums and communication channels, as well as sharing travel experiences and resources with peers. Collaborative service functions allow users to propose their personal travel plans to the community, to exchange ideas and collaboratively design alternative travel plans

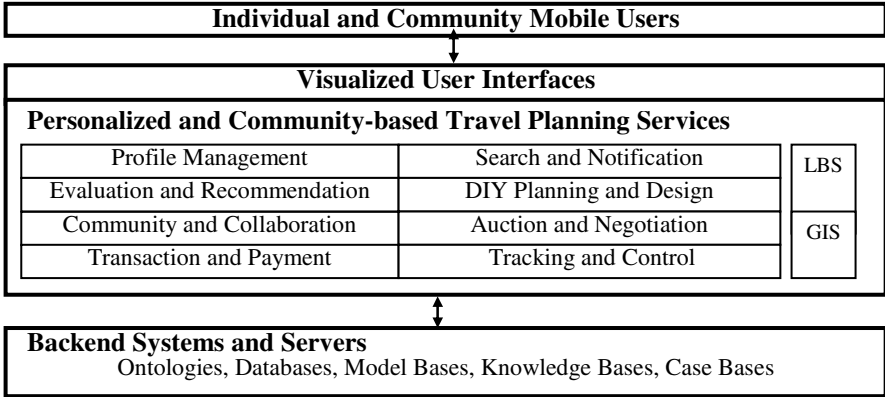


Fig. 1. The integrated service framework for travel planning and management

with interested members, to resolve conflicts, vote for proposals, and select ones with the highest votes as the commonly accepted group travel plans for implementation. The initial proposal can be a result of the DIY planning process or a previously implemented case recommended by the system based on the CBR technique.

Mobile Auction and Negotiation: This functional group provides a dynamic and competitive pricing environment for users to issue tourism requests with specified needs and preferences, and to launch reverse auction sessions that call for tourism service providers to bid on the posted individual or group travel plans. The submitted bids are evaluated and those with top satisfactory cost/benefit levels are selected as candidates for contract negotiation. The negotiation function allows users to negotiate with chosen tourism service providers by exchanging modified terms and contracts.

Mobile Transaction and Payment: This functional group allows users to use mobile devices for actually booking and issuing payments to selected tour plans, for hotel or restaurant reservation, or for purchasing tourism related products such as train tickets, museum directories, or destination-specific souvenirs.

Mobile Trip Tracking and Quality Control: This group of functions provides mechanisms for travelers, their families, and the travel agents to track during-the-trip locations and situations, and if necessary, make changes to the operating travel plans by rearranging routes, points of visit, restaurants, or hotels for assuring the safety and quality levels of the travel plans.

Associated Location-Based Services and Map Services: These services take into account traveler’s current location and time for finding nearby point-of-interests or planning an area trip. The spots to be visited as well as their routes are shown using Google Map.

3.2 The Integrated Process Model

Based on the proposed integrated service framework, the process model for mobile travel planning and management is depicted in Figure 2 with associated steps being described below.

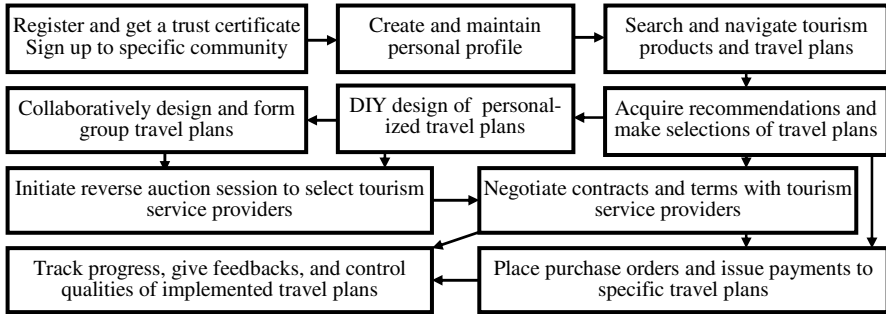


Fig. 2. The integrated process model for travel planning and management

1. Users can register as a member and get trust certificate, and also sign up to join specific communities.
2. Users create and maintain personal profiles that contain categorized data about users' basic information, personalized travel related needs, preferences, and constraints, past travel histories with implemented travel plans, photo albums, and text descriptions, link lists of favorite web pages, as well as personalized evaluation criteria for selecting tourism products and services.
3. Users search and navigate tourism-related information such as destinations and accommodations, attractions and features, package tours and travel agencies, etc., as well as to access other users' experiences, ratings and resources related to specific destinations and accommodations. Users also receive product or event notifications relevant to their needs, preferences, and conditions.
4. Users activate the evaluation and recommendation procedure using specified criteria to choose tourism products and vendors, or past travel cases that meet their needs and preferences with specified matching or similarity levels.
5. Users design personalized travel plans when there is no existing package tours or travel cases with the pre-specified satisfaction levels recommended by the system.
6. Users can join or form communities of special interests, locate and organize users of similar interests to exchange experiences and ideas, and design collaboratively with community members to develop commonly accepted group tour plans.
7. Users propose requests and initiate reverse-auction sessions for inviting tourism vendors and services providers to bid on proposed individual and/or group tour plans, as well as to evaluate and select those with best bids as candidates.
8. Users negotiate terms and contracts of the selected tour plans with chosen tourism service providers such as travel agencies and tour operators.
9. Users can book and pay for selected tour plans, and receive new and just-in-time information in pull and push manners.
10. Users can track the progress and control qualities during the tour operations of the contracted travel plans.

With planning and decision support services to this extent, all pre-, during, and post phases of the tourism and travel related decision-making process can be fully supported through successfully incorporated personalized and community services.

4 The Design Method and Prototype System

For developing the integrated mobile travel planning and management support system, the scopes of system design include architecture design, process design, user interface design, presentation design, database design, model base design, knowledge base design, as well as the ontology and case base design, etc. In the following, design considerations for ontologies, databases, model bases, knowledge bases, and case bases, as well as an implemented prototype are provided.

4.1 Ontology, Database, Model Base, Knowledge Base, and Case Base Design

For constructing tourism ontology and user ontology, as well as for designing the system database, model base, knowledge base, and case base, an unified Object-Oriented (OO) model design approach is adopted to create the integrated conceptual data model. The OO model is then translated into internal models for implementing associated databases, model bases, knowledge bases, and case bases that conform with the ontologies. For instance, an entity-relationship (ER) model is derived and further transformed into a relational model for physical database implementation. Figure 3 presents partially the OO data model in which identified objects include Traveler Profile, Tourism Information, Travel Plan, and Recommendation Process. The Traveler Profile object composes of Needs and Preferences (N&P), Search Constraint and Criteria, as well as Current Location and Time objects. The Needs and Preferences object is further classified into Sightseeing N&P, Restaurant N&P, and Hotel N&P objects. The Tourism Information object aggregates three sub-class objects including Sightseeing Spots Information, Restaurant Information, and Hotel Information objects, as well as packaged travel plan and past case objects. The Recommendation Process object has several component Match Process objects including Ontology Match Process, Case-Based Reasoning Process, and Knowledge and Model Computing Process objects. Each Match Process object contains specific Process Input, Process Execution, and Process Output objects. For instance, the Process Execution objects for the Knowledge and Model Computing Process comprise Model Input, Recommendation Model, Model Output, Rule Input, Recommendation Rule, and Rule Output objects. The recommended Travel Plan object consists of Sightseeing Spot Selection, Restaurant Selection, and Hotel Selection objects as the components.

4.2 The Prototype System

A prototype system that provides the integrated personalized and community services for mobile travel planning is developed in an environment using system and application software such as Windows XP, Microsoft IIS Web Server 5.1, .NET Framework 2.0, and Microsoft SQL Server 2005, as well as ASP.NET 2.0, Web Services, and Google Map API 2.0. The CHT Windows Mobile 5.0 Smart Phone Emulator is used as the client-side emulator. The prototype system allows travelers to access desired personalized and community services for travel planning via PDAs or smartphones. Sightseeing spots, restaurants, and hotels can be selected, or a packaged

travel plan (for individual or group) can be generated based on travelers' needs, preferences, constraints, conditions, and specified evaluation criteria. Figure 4 shows example mobile phone screen shots of the prototype system including updating the traveler profile, needs setting for search travel plans, presenting the recommended travel plan, and showing a map with the route and sequential visits.

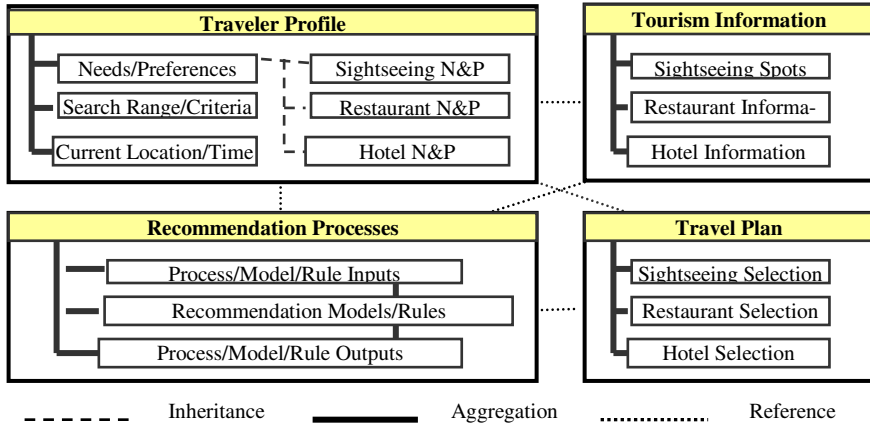


Fig. 3. The Object-Oriented conceptual data model



Fig. 4. Output screenshots of the prototype system

The prototype system has been evaluated by 32 graduate and EMBA students who have both travel planning and mobile application usage experiences. Based on a 5-point Likert scale (1 as strongly disagree and 5 as strongly agree), the average scores of the 4 performance measures including usefulness, ease of use, satisfaction, and intention for future use are 4.09, 4.14, 3.79, and 3.86 respectively with the overall average score being above 3.97. These outcomes validate the feasibility and effectiveness of the proposed framework, process, and design methods.

5 Concluding Remark and Future Works

In this paper, we present an integrated service framework, process model, and design methods for guiding the development of personalized and community-support mobile travel planning and management services. A system prototype is also developed and tested to validate the feasibility and effectiveness of the proposed approach with satisfaction. Future research works include evaluating efficiency and effectiveness of the system using real world cases, comparing the performance of ontology matching, case-based reasoning, with model/knowledge computing mechanisms using various scenarios, as well as integrating web 2.0 technology into the system.

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