IEBSR: An Integrated e-Tourism Service for Self-Guided Travel

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Abstract. Instead of joining a package tour, many people become backpackers and choose self-guided travel for many reasons, especially when it is much easier to find travel information nowadays. Thus, many social websites are popular now for backpackers. We noticed that the issues discussed in those websites can be classified into three major types: making a travel plan before departure, asking for instant help on the journey, and sharing experiences after home. After searching related travel information and making a detailed travel plan, one usually writes or prints the plan on a small and portable paper notebook for reference on the journey. However, it is inconvenient to look up specific information in the paper notebook. In this study, an integrated e-tourism service for self-guided travel, named IEBSR, is presented. IEBSR consists of four major components: (1) a web-based itinerary editor where a user can make a complete and detailed travel plan, (2) an itinerary browser app for smart mobile devices in which a user can easily browse her travel plan anytime and anywhere, (3) an itinerary sharing and discussion subsystem, and (4) an itinerary recommendation subsystem. IEBSR integrates with Google Maps and other travel information systems. Thus, users can edit their travel plans intuitively on the map. They can easily and quickly browse the information recorded in a travel plan in the app based on the GPS location information sensed by their smart mobile devices. With itinerary sharing and recommendation, they can customize a proprietary travel plan from an existent one. Experiment results have successfully demonstrated that the proposed integrated e-tourism service can help backpackers significantly.

Keywords: Self-Guided Travel, Backpacking, e-Tourism, Itinerary Editor, Itinerary Browser, Itinerary Recommendation, Smart Mobile Device, Location-Based Service, Mashup

1 Introduction

Instead of joining a package tour, nowadays more and more people become backpackers and choose to make a self-guided travel for many reasons. For example, one can select which sites to visit and decide how much time to spend in these sites of his or her own free will. Or one is in a business trip and wants to make a tour in a free time slot. However, it is not easy for backpackers to make a complete and detailed travel plan, especially in an unfamiliar region, since they have to arrange everything of the journey, such as to book flights, hotels and restaurants, to select and schedule the sites to visit, to look into the opening and closing times of these sites, to search proper transportations, to manage their budget, and so on [1]. We noticed that in Backpackers' Inn [2], a very famous Chinese social website in Taiwan for self-guided travel, the issues and discussions can be classified into three major types.

1. Issues about making a travel plan before departure. Although a lot of information can be found in the Internet, some are not. Some information found in the Internet is out-of-date, and some is temporarily inapplicable. Many backpackers posted their intended travel plans and requested for opinions, especially from local residents or experienced travelers.
2. Instant help on the journey. Many backpackers had no enough time to make a complete and detailed travel plan. After they departed, they still revised their plan and asked for opinions whenever they cloud access the Internet. Or an unpredictable event occurred. The travelers had to change their schedule. Thus, they deeply hoped somebody could answer them quickly.
3. Experience sharing after home. After finishing a tour, many backpackers liked to share their experiences, successful or unsuccessful. In addition, they could give some invaluable suggestions to others about a proposed travel plan.

Due to the rapid improvement of information communication technologies, it is very easy for backpackers to search travel information from many data sources, such as blogs, social websites, e-books or e-journals of travel, and so on. As well, travel information systems for various purposes have emerged. For example, backpackers can online book flights, hotels and restaurants, look up sites on digital maps, share experiences and read comments of sites, and so on. In fact, e-tourism has become a leading application in business-to-consumer (B2C) e-commerce. However, these services are usually independent. As a result, the information is scattered.

In the literature, many studies on e-tourism had been reported in different applications, e.g., to select and schedule sites to visit, to make a recommendation of sites or tours, to plan possible transportation between sites, and so on [3-11]. In [3], based on semantic web and ontology technologies, a project was presented to deal with business-to-business (B2B) integration to allow tourism organizations with different data standards to seamlessly exchange information without having to change their proprietary data schemas. In [4], a genetic algorithm was adopted to select sites to visit according to the preferences of group members. In [5], an e-tourism service was presented that incorporated hybrid techniques and various metrics to makes recommendations based on the user's tastes. In [6], a hotel recommendation system was presented that applied fuzzy logic techniques and consumers' experiences to relating customer and hotel characteristics. In [7], a recommendation system that integrated with GIS (Geographic Information System) and ontology-based artificial intelligence algorithms was presented. In [8], semantic web technologies combined with software agents were used to support needs of travelers. In [9], task model and task ontology were presented for travelers' tasks and activities. Many of them applied advanced ontology, semantic web, and software agent technologies. However, the real world is too complex to be implemented entirely within an information system. In [10], analytic hierarchical process (AHP) was proposed for ontology modeling in e-tourism domain. In [11], many research directions and opportunities in recent years and the near future had been discussed. To the authors' best knowledge, none of these algorithms and systems is matured for real applications. Many recommendations generated by existent travel information systems are far from best choices, since the knowledge of sites, transportations, and many others is incomplete and the algorithms to make recommendations are very limited. Thus, backpackers still have to search related travel information from various travel information systems to customize a travel plan for themselves.

In addition to maps and books of travel guides, many backpackers will also carry a paper notebook on which they have written or printed their travel plan for reference on the journey. However, the travel plan written on the paper notebook is usually incomplete and in a mass due to many reasons, e.g., the paper notebook is small for portability and the structure of a travel plan is complex. As a result, it is inconvenient for backpackers to look up specific information in the paper notebook, especially when they are in a rush.

In this study, an integrated mobile e-tourism system for self-guided travel, named IEBSR (Itinerary Editing, Browsing, Sharing, and Recommendation), is presented. IEBSR consists of four major components: (1) a web-based itinerary editor, (2) a mobile itinerary browser app, (3) an itinerary sharing and discussion subsystem, and (4) an itinerary recommendation subsystem. IEBSR also integrated with some other information services, e.g., Google Maps [12] and Picasa [13]. Users can edit their travels plans on Google Maps intuitively. They can detail many different types of information in their travel plans. After making a travel plan, they can browse it in their smart mobile devices, e.g., smart phones or pads. When taking offline into consideration, they can also cache the travel plan and the related data in their smart mobile devices in advance. With built-in GPS (Global Position System) of smart mobile devices, the app can instantly display the related information of the site the user is visiting. Based on the concept of collaborative computing and web 2.0 [14], users can share the information of a site or travel plan to others. IEBSR integrated with a content management subsystem where users can discuss about a site or travel plan. By the recommendation subsystem, users can find a travel plan based on their preferences among those shared by others and customize it for their own private interests. Thus, users have not to make a whole new travel plan from scratch. A prototype of IEBSR has been set up. Experiment results on the prototype system have successfully shown that IEBSR can help self-guided travelers very much.

In the followings, Section 2 describes the design of IEBSR, Section 3 presents a prototype implementation of IEBSR and the experiment results, and finally, Section 4 gives our conclusion and intended future works.

2 System Architecture

Fig. 1 shows the system architecture of IEBSR. It consists of four major components: (1) a web-based itinerary editor, (2) a mobile itinerary browser app, (3) an itinerary sharing and discussion subsystem, and (4) an itinerary recommendation subsystem.

When a user wants to make a travel plan in a region, she can first pick up a proper travel plan as a base by the recommendation subsystem. She can read the comments about a site or transportation from the sharing and discussion subsystem. She can search travel information and make reservations in 3rd party information systems. Then, she can record the related travel information in the itinerary editor and customize her proprietary travel plan. After making a travel plan, she can download (or cache) the plan and the related information and objects into her smart mobile devices. With the app, she can browse the travel plan on the journey. Based on the GPS location information, she can instantly read the related information of the site she is visiting.

In this section, we first describe the structure of a travel plan, and then show the design goal of each component and how these components are combined together to help self-guided travelers.

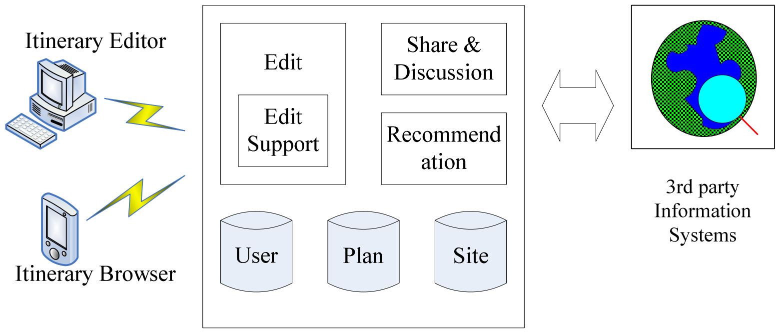


Fig. 1. System Architecture of IEBSR

2.1 Structure of Travel Plan

Table 1 shows a simple travel plan example. In general, a travel plan consists of several segments. Each segment contains a destination site, the duration of stay in the site, the possible transportations to the site, and the tasks to be done in the site. In the example, the destination site of each segment is underlined and bold. There are many different types of information of a site, such as its names, longitude, latitude, address, phone numbers, and so on. The transportation consists of a series of moves. Each move specifies the possible types of transportation and necessary information, such as bus number, the departure and destination stations, the departure and arrival time, and so on. In addition, there may be some special tasks to be done in a site, such as to rent a bicycle and to buy souvenirs in the example.

It is worth noting that strings in the local script are very useful, such as names and addresses. When asking for help, a backpacker can show these strings to local residents.

Table 1. A simple travel plan example

Date	Description
10/1	18:35 lands on **CKS Airport**. Shuttle bus (1st floor) to Taipei station (1hr). Blue line MRT to Ximen (西門) station. Walk to **XYZ Hotel** (123, Sec 4, Zhongshan Rd. 中山路 4 段 123 號. 02-33665588). Dinner at **Breeze Inn (微風小館)** near the hotel.
10/2	Blue line MRT to Taipei station. Red line to Shihlin (士林) station. Bus #255, 304, 815, or Red 30 to **Palace Museum (故宮)**. Bus back to Shihlin (士林) station. Dinner at **Shihlin night market (士林夜市)**.
10/3	Blue line MRT to Taipei station. High Speed Rail to Taichung HSR station (1hr). Nantou Bus (南投客運) (1st floor) to **Sun Moon Lake (日月潭)** (2hr). Call (04-87654321) and check in **ABC Hotel** (678 Circular Rd). *Rent a bicycle. *Buy souvenir.
10/4	Nantou Bus (南投客運) back to Taichung HSR station (2hr). Free Bus 11 to **Tunghai University** (0.5hr). *Visit **Louis Church** (2hr) Free Bus 11 back to Taichung HSR station (0.5hr). High Speed Rail to Taoyuan (桃園) HSR station (1hr). Bus (1st floor) to **CKS airport** (0.5hr). Check in before 20:30. 22:15 departs.

2.2 Itinerary Editor

The first and the most important component of IEBSR is the itinerary editor. Nowadays, users can search a lot of travel information in the Internet. However, the information is scattered in many different information systems. For backpackers, they need a system to integrate the information into their travel plan.

As shown in Table 1, there are many different types of information in a travel plan. Two databases are designed. One is for sites, and the other is for itineraries. Fig. 2 shows the structure of a travel plan stored in the proposed system. To simplify the design, a travel plan consists of moves. Several successive moves logically make a segment. If the *start_site* attribute of a move is empty, it is assumed by default to be the *end_site* of the previous move. If the *public* attribute of a travel plan is set, the plan is shared by the creator to the public. Others can view it and replicate it as a base of a new travel plan.

There are two types of sites: public or private. For public sites with the *public* attribute set, every user can view and edit the information of them. On the other hand, only the creator can view and edit the information of a private site. In a same location, users can create multiple sites for different purposes when necessarily. Many types of information are supported, e.g., names and addresses in multiple scripts, longitude, latitude, phone numbers, home pages, contact emails, reference URLs of blogs, and so on. Since an information entry may become out-of-date, users can comment or revoke the entry. Similarly, users can comment or revoke an entire site.

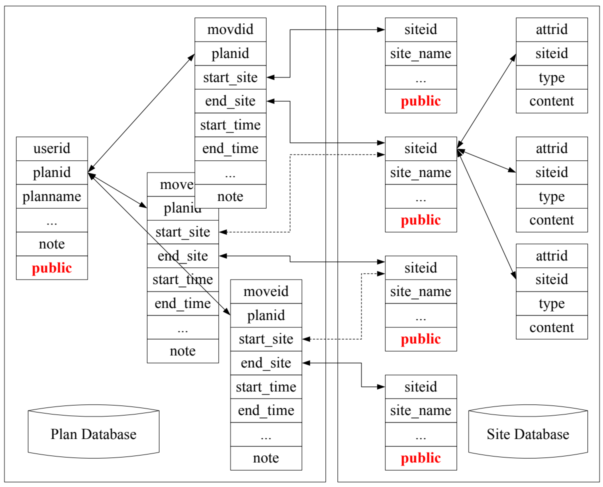


Fig. 2. Structure of a travel plan

Based on the concepts of SaaS (Software as a Service) and multi-tendency [15], a web-based itinerary editor is designed that supports the followings.

1. **Site Management**. A user can create public or private sites on a digital map intuitively. Many different information types are supported, e.g., names, addresses, and so on. In addition, she can specify the functionality of a site, which is a combination of transportation, accommodation, food and drink, shopping, entertainment, natural sightseeing, cultural heritages, public facilities, and so on. Thus, she can search sites in the digital map by functionality. She can comment a site or an information entry of a site. Furthermore, she can revoke a site or an information entry of a site when the information is out-of-date.
2. **Itinerary Management**. A user can create an empty travel plan or replicate a travel plan as a base from those shared by others in the itinerary database. She can insert a move into the travel plan and designate its destination site, duration of stay, possible transportations, and intended tasks. She can modify a move or delete it from the travel plan. She can schedule moves in any order. She can share a travel plan to the public. She can search a public travel plan based on her preferences from the recommendation subsystem.
3. **Integration with other IEBSR components.** A user should be able to use the itinerary editor intuitively to access other components in IEBSR, i.e., the itinerary sharing and discussion subsystem, and itinerary recommendation subsystem. In the itinerary editor, she can comment or revoke a site or an information entry; as well, she can search a site or travel plan.
4. **Integration with 3rd party information services**. Backpackers usually have to check where a site locates in the map. Digital maps, such as Google Maps, are widely used in e-tourism now. Based on the concept of mashup [16], the itinerary editor should be a user-friendly web application and integrate with 3rd party information services, such as Google Maps, to provide digital map and location information of sites. As well, navigation systems can offer transportation suggestion.

2.3 Itinerary Browser

When on the journey, backpackers usually have to reference their travel plan. Many backpackers print or write their travel plan onto a paper notebook; however, it is sometimes inconvenient to look up the travel plan on the paper notebook. For example, they are in a crowded bus and not sure whether the destination is approaching. In fact, a complete and detailed travel plan is naturally a hypertext and therefore not suitable to be recorded onto papers. When referencing a site, a user may want to read its descriptions in different web pages, locate it on the maps, or look up the transportation information. It is not easy to put these relevant objects in a good order on a paper for all possible browsing ways.

Smart mobile devices, e.g., smart phones and pads, are very popular now. With high-speed Internet access, a larger storage, powerful CPUs, and many useful sensors, they become much better carriers of information. Especially in the e-tourism domain, the authors believe that smart mobile devices are preferred media for backpackers to store and view their travel plan.

In IEBSR, the itinerary browser is designed to be an app of smart mobile devices supporting the followings.

1. **To browse a travel plan**. A user can use the app to browse a travel plan anytime and anywhere, even if the creator had not yet completed the travel plan. Users can browser a travel plan in different viewpoints, e.g., the overall picture of a travel plan, summary of a logical segment, or detailed information of a move. Based on the concept of mashup, the app can show contents from 3rd party information systems directly or indirectly, e.g., display a site in Google Maps.
2. **To browse a site**. In a move, the app can show the related information of a site recorded in a travel plan. It must be able to handle well known information types, such as addresses and phone numbers. The app can show contents of a site from 3rd party information systems directly or indirectly, e.g., show a remarkable picture of a site, access its official website, or view a blog post about it.
3. **Integration with other IEBSR components.** On the journey, users can instantly view and comment a site or travel plan. When a new comment is made, it will be real-time delivered to the app so that the users will be notified. For example, when a user finds that a site is temporarily closed, she can post a comment of this event to the site. Others who are visiting or will visit the site will be notified if they have included the site in their travel plan.
4. **Integration with 3rd party information services**. On the journey, users can use the app to access 3rd party information services, such as Google Maps and others by the name of a site. The app can use URLs stored in the travel plan to further access relevant information services, such as official websites and the time table of transportation.
5. **Offline operation**. On the journey, users may lose Internet connection. When taking this into consideration, it is very useful to cache travel plans and relevant objects in advance. The app can traverse the itinerary on a 3rd party digital map and cache related maps. As well, the app can download some remarkable pictures of sites.
6. **To leverage built-in sensors**. For example, the app can leverage the GPS location information sensed by the smart mobile device. Thus, the app can automatically display the information of the site the user is visiting without user interfacing.

2.4 Itinerary Sharing and Discussion Subsystem

When a travel plan is shared, all users in IEBSR can view and comment it. In this subsystem, a simple content management mechanism is designed. A user can append many comments of a site or travel plan. Comments of a same object are threaded and all users can read them. In addition, users can appreciate or disagree about a comment. With a mechanism like hotter or notter, comments are ranked. As a result, users can quickly read the most appreciated comments of a site or travel plan.

Similarly to [17], users can give their experience scores of a site or travel plan in this subsystem. A site may have complex functionalities; people may receive different experiences in these functionalities. For example, in addition to their primary functionalities, an amusement park usually provides basic food and drinking, while in a department store there are usually many good restaurants. Currently, four scores are adopted for a site, namely *natural scene*, *history and culture*, *shopping*, and *food and drinking*. Every user can give the scores to a site. These scores are independent. From the scores given by different users, we can perform more in-depth investigation of a site or travel plan. As well, these scores serve a very good base for itinerary recommendation, as described in the next subsection.

2.5 Itinerary Recommendation Subsystem

It usually takes a lot of time to create a travel plan from scratch, especially in an unfamiliar region. In [2], we noticed that many backpackers customized a new travel plan for themselves based on others' travel plans. Similarly, users in IEBSR can choose a travel plan made and shared by others from the itinerary database. To meet this need, an itinerary recommendation subsystem is designed.

The itinerary recommendation subsystem must take user preferences into consideration.

A very simple mechanism is adopted. As described in the previous subsection, a user u can give a site s four experience scores: *natural scene* ($f_1^s{}_u$), *history and culture* ($f_2^s{}_u$), *shopping* ($f_3^s{}_u$), and *food and drinking* ($f_4^s{}_u$). The scores are between 0 and 10, i.e., $0 \le f_i^s{}_u \le 10$ for i=1, 2, …, 4. The higher a score, the better experience the user received. For a site s, its four scores, i.e., f_1^s, f_2^s, …, f_4^s, are the average scores of all users, as shown in eq. (1).

$$f_i^s = \text{average}(\ \{ f_i^s{}_u \}\ ), \text{ for } i=1, 2, \ldots, 4. \quad \textbf{(1)}$$

Every itinerary p stored in the database has a feature vector of the four scores, F_p={ f_1^P, f_2^P, …, f_4^P }. Since there are several sites in the itinerary, the scores of the itinerary are an accumulation of all visited sites, as shown in eq. (2).

$$f_i^P = \text{sum}(\ \{ f_i^s \mid s \in p \}\ ), \text{ for } i=1, 2, \ldots, 4. \quad \textbf{(2)}$$

When a backpacker wants to choose an itinerary from the database, she can specify her preferences into the recommendation subsystem, which are the aforementioned four scores, i.e., *natural scene* (q_1), *history and culture* (q_2), *shopping* (q_3), and *food and drinking* (q_4). These scores form a preference vector, Q={ q_1, q_2, q_3, q_4 }. Again, the scores are between 0 and 10, i.e., $0 \le q_i \le 10$ for i=1, 2, …, 4. If the user wants to receive a better experience in one concept in her itinerary, she inputs a score larger than 5.

Thus, we can roughly estimate the similarity of a user's preference vector and the feature vector of an itinerary, as shown in eq. (3). Itineraries of a higher similarity with the preference vector are recommended to the user.

$$Sim(Q, F_p) = \sum_{i=1}^{4} q_i \times f_i^P. \quad \textbf{(3)}$$

3 System Prototype and Discussion

In this section, we describe a prototype implementation of IEBSR. Although the prototype system was unrefined, most testers of it were impressed. The experiment results have demonstrated IEBSR can help self-guided travelers significantly.

3.1 Web-based Itinerary Editor

As shown in Fig. 3, a web-based itinerary editor on top of Google Maps was constructed. After login, a user can create new a new travel plan or edit an existent one.

Fig. 4 shows site management. The user can create a site intuitively on Google Maps. She can insert the site into the travel plan, and it will be listed at the right hand side of the editor, as shown in Fig. 3. Or she can input the name of a site in the search box, i.e., 

, as shown in Fig. 4(a). She can add or modify related information entries of the site in any types, e.g., multiple address entries, one in her native script and another in the local script. She can specify the functionalities of the site, such as  (food),  (accommodation), and so on. Thus, she can browse only the hotels arranged in a travel plan. She can share the site to the public, as shown in Fig .4(b). Based on the concept of collaborative computing and web 2.0 [14], as more travelers use this system, more sites will be described in detail and stored in the system. Hence, users can reuse the information of public sites at most time and do not have to create a new site.

The user can use Google Maps or other information systems to search possible transportations between sites. When she specifies the duration of a site where she wants to stay and the possible transportations, the move is stored in the database. The itinerary editor will automatically sort and show all moves in the travel plan according to the start time of a move. She can fold () a move to keep itinerary area simple and clean in the right hand side of the editor. Or she can unfold () a move to read more detailed information. She can manually reorder moves by drag and drop. At the moment this paper was written, a simple time check was implemented. If the durations of two moves are overlaid or inconsistent, an alarm will be issued to the owner of the travel plan. Hence, she can easily notice that some conflicts in her travel plan must be resolved.

More details of the web-based itinerary editor in IEBSR were given in [18].

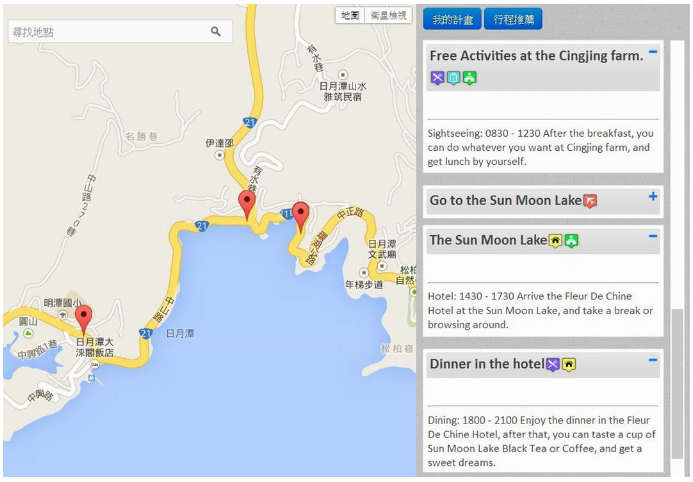
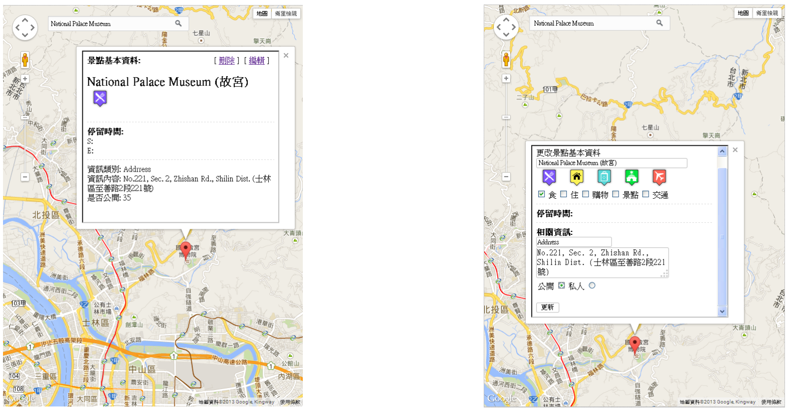


Fig. 3. Web-based itinerary editor built on top of Google Maps



(a) (b)

Fig. 4. Site management in the web-based itinerary editor

In the future implementation of the web-based itinerary editor, we will study more advanced automations, e.g., recommendation of sites and the duration of stay, cross-checking their opening and closing times, scheduling of sites and conflict resolution, route planning and optimization, and so on.

3.2 Itinerary Browser App on Android

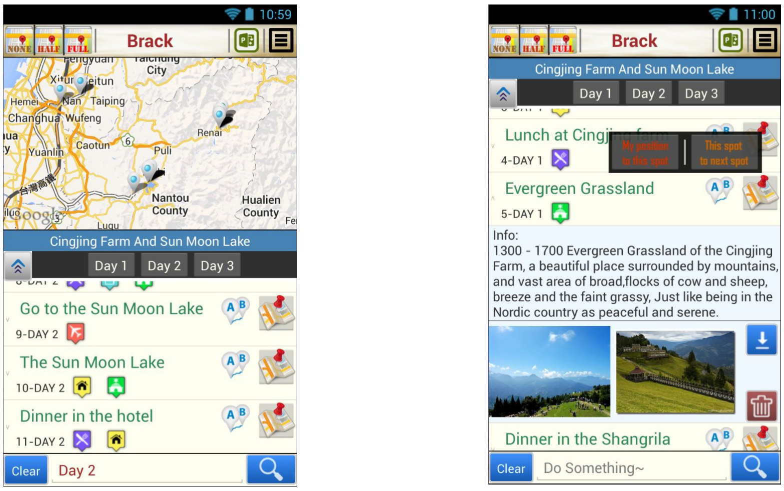
Fig. 5 shows some snapshots of the itinerary browser app for smart mobile devices. Currently, the app is for Android smart phones and pads. Versions of the app for other systems are under development.

After login, a user can download her travel plans from IEBSR. For information exchange, XML is adopted. Based on the design shown in Fig. 2, we devised a simple XML format to describe a travel plan. A PHP module was developed to convert a travel plan stored in the database into the specified XML format. When IEBSR is accessed by the app, the PHP module is invoked. Then, the requested travel plan in XML is returned to the app. The app parses the travel plan in XML and shows the plan to the user, as shown in Fig. 5(a). We note that the user cannot edit travel plans in the app. She has to use a web browser installed in her smart mobile device to access the web-based itinerary editor.

With built-in GPS sensor, the app can learn the current location of the user. As a result, the app can quickly show to the user the related information of the site on the journey. Or the user can click to manually center Google Maps to a specified site. Although the user probably had planned the transportations betweens sites in advance before they depart, the information is probably incomplete or become useless due to unpredictable events. She has to find alternatives immediately. She can click to request for help from Google Maps.

In addition to tightly integration with Google Maps, a traveler can use the app to access 3rd party information systems. As shown in Fig. 5(b), when she unfolds a move, the app shows not only the description of a site, but also some remarkable pictures of the site from Google Picasa, which is a popular social website for the public to share their pictures. Imaging a situation, when she shows only the text description to a local resident on the street to ask for help, the local resident shakes his head just because he does not know the name of the site in

English, *evergreen grassland*, and in fact, which is very famous in Taiwan. On the other hands, with the pictures, he knows the site is a beautiful green land in a mountain. Then, it is possible he can successfully guess the meaning of the word *grassland*, combined with the words *evergreen*, (長青, 常青, or 常綠 translated into Chinese by meaning) and Cingjing (清靜 translated into Chinese by pronunciation), and finally figures out that *evergreen grassland* is the famous site, 青青草原, in Taiwan.



(a) (b)

Fig. 5. Itinerary Browser App on Android Smart Phones

The uses can cache the travel plan, digital maps, and related objects in the app for offline itinerary browsing. The app can automatically traverse on Google Maps according to the itinerary. Due to the limitation of Google Maps, the maps are stored as bitmap images in the local storage of the smart mobile devices. Since the size of these bitmap images is very large, a smart algorithm for this issue is under investigation. The user can download related objects. For example, she can click to cache the pictures into her smart phone.

3.3 Itinerary Sharing and Recommendation

We had used a small questionnaire to survey the travel experience scores of 20 young students in June, 2011. The respondents were between 19 and 30 years old. A half of them were boys. They all had made several self-guided travels and visited many sites in Taiwan.

We prepared 30 sample itineraries in different travel styles, which included 82 famous sites in different areas of Taiwan. For each of the 82 sites, we asked the respondents to give the four aforementioned scores, i.e., *natural scene* ($f_1{}^s{}_u$), *history and culture* ($f_2{}^s{}_u$), *shopping* ($f_3{}^s{}_u$), and *food and drinking* ($f_4{}^s{}_u$). In addition, we devised 10 preference vectors in different travel styles. For each preference vector, the respondents were asked to pick up 5 most relevant itineraries from the 30 sample itineraries in their independent opinions. Then, top 6 itineraries selected by the most respondents were recognized, referred to as *relevant_set*.

We then evaluated the simple recommendation mechanism presented in subsection 2.5. For each preference vector, the similarities with the 30 sample itineraries were estimated by eq. (3) and ranked. Top 6 itineraries of highest similarities were recommended, referred to as *retrieved_set*.

This survey was small and limited. The adopted algorithm was very simple. However, the results were acceptable to a certain extent. Table 2 shows the values of precision and recall for each preference vector when its corresponding *retrieved_set* is compared to its *relevant_set*. Values of precision and recall are calculated by eq. (4) and (5). As shown in Table 2, for each preference vector, at least two of the six recommended itineraries were in the top six relevant ones selected by 20 independent respondents among the total 30 sample itineraries. In other words, users can examine the six itineraries in the *retrieved_set* quickly and find a relevant itinerary as a base to make their own travel plan.

More detailed results of the itinerary recommendation in IEBSR can be found in [19].

$$Precision = \frac{|retrieved\_set \cap relevant\_set|}{|retrieved\_set|}. \quad \textbf{(4)}$$

$$Recall = \frac{|retrieved\_set \cap relevant\_set|}{|relevant\_set|}. \quad \textbf{(5)}$$

Table 2. Precision and recall of the simple recommendation mechanism*

	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8	Q_9	Q_{10}	Average
Precision	0.33	0.67	0.67	0.5	0.5	0.33	1.00	0.17	0.67	0.67	0.55
Recall	0.33	0.67	0.67	0.5	0.5	0.33	1.00	0.17	0.67	0.67	0.55

* Since the sizes of the *relevant_set* and *retrieved_set* were the same, the values of precision and recall were the same.

4 Conclusion

E-tourism is a leading application in e-commerce and hot research area. Many efforts had been made in the relevant industries and reported in the literature [3-11, 17]. However, most existent e-tourism information systems can make good jobs in certain fields, such as searching related information in the Internet, online booking airline tickets and hotels, recommending a site to visit or a hotel to stay, or planning transportation between sites. These systems are usually independent without integration. As a result, it is still hard for backpackers to make a complete and detailed travel plan. When a travel plan is made, many backpackers write or print their plan on small and portable paper notebooks. However, it is inconvenient for backpackers to look up specific information in the paper notebooks, especially when they are in a rush.

In this study, a mobile e-tourism system for self-guided travel, named IEBSR, is presented. IEBSR consists of four major components: (1) a web-based itinerary editor, (2) a mobile itinerary browser app, (3) an itinerary sharing and discussion subsystem, and (4) an itinerary recommendation subsystem. We've prototyped a web-based itinerary editor and an itinerary browser app for Android smart phones and pads. Users can edit their travel plan on Google Maps intuitively, and store related information in various types in IEBSR. Then, they can browse their travel plan in the app with the GPS location information sensed by their smart mobile devices. In addition, users can share their travel experiences or comment visited sites in the itinerary sharing and discussion subsystem. They can give their experience scores to a site or travel plan. Based on these experience scores, the itinerary recommendation subsystem can recommend proper travel plans from those shared by others to users. Thus, users who want to travel in an unfamiliar area do not have to make a whole new travel plan from scratch. They can customize a travel plan based on an existent one. Experiment results on the prototype system have shown that the proposed integrated e-tourism service, IEBSR, can help self-guided travelers significantly.

In the future, we will study more advanced automations in IEBSR. For example, the web-based itinerary editor can automatically check the opening and closing time of sites, notify the user with conflicts in the visiting order of sites, and so on. The itinerary browser app can give an alarm that the user will be late for a train, or notify her that a site is temporarily closed.

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