Personalized Tour Planning System Based on User Interest Analysis

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Abstract

The rapid progress of computer technology has dramatically changed our daily life. More and more traditional services have been moved onto web. In this paper, we introduce a novel idea to support individual trip planning, a personalized tour planning system (PTPS) which is a web application that helps tourists(users) design their own tour plans. The proposed system has the following unique components: 1) a tour planning framework (TPF) that guides users in selecting destinations that satisfy their specific needs; 2) a user interest analysis model which is introduced and deployed to trace the users' behaviors and preferences; 3) a rule based evolving model for TPF that makes it very adaptive to various users. In supporting such a system, traditional functional components for a travel guide systems such as tour-guide maps, introductions to famous sites in China, flight schedules, train timetables, hotel descriptions and other related information.

1. Introduction

With the blooming of web technology and popularity of popular PCs, not only increasing number of people have become computer users (information consumers), but also increasing number of users have become information providers. Seeking correct and accurate information from a gigantic mass has been a true challenge these days, which can be compared to picking up a needle from the boundless ocean. In many cases, too many choices are equivalent to no choice, Therefore, research on search engines and various filtering technologies become one of the hot subjects [Lawrence, Giles 1999] [Lieberman, Letizia 1995]. A search engine is to facilitate users to find pages with certain contents that match users' needs, normally through using one or more key words. To be benefited from a search engine, one must know clearly what he (she) wants and precisely grasps the real key words in most search engines. The aim of filtering is to automatically find out web pages or messages that a particular user may be interested and to filter out most irrelevant data. Filtering is usually discussed in the context of personalization and research on this topic has been flourishing in recent years in the literature. The general idea of filtering involves three steps: 1) collect personal info explicitly (through questions) or implicitly (by tracing behaviors); 2) map personal info to preferences and store them in user profiles; 3) create filter rules and do the filtering based on users' preferences. However, in the literature, the applications of personalized information filtering are mainly on web page selection, documentation recommendation [Balabanovic 1996] and email management [Höfferer, Knaus, Winiwarter 1994]. We propose a novel idea to use personalized information filtering techniques in tour planning.

China is famous for its countless ancient temples, gardens and gorgeous natural cities. The beauty of nature and history in China attract tens of millions of tourists every year. Though joining a tour group organized by a travel agent is a good choice, many people still choose to make their own travel plans to fulfill their specific needs. Currently many web sites have been set up by the tourist attractions for visitors, for example, 3132 web sites are retrieved using key word 'tour' on the yahoo search engine. These web sites fall into two categories: (1) web sites that introduce places or regions set up by the government branches or local administration to promote their tourism resources, and (2) web sites that advertise tour group organization established by the travel agents. Till now, no web site in China is providing supporting services for the users to make their own tour plans. In this study, we propose a new model to develop a web-based system that will facilitate users in designing their own specific tour plans. The system consists of three parts – a

database storing tourism related information, a tour planning subsystem to guide a user to create his (her) own travel plan, an E-mall subsystem to provide travel related services and products such as hotel reservation, flight ticket booking, special shoes and other travel products commerce etc. The database is the foundation of the proposed tour planning system and the E-mall service helps users to get services immediately after they made a solid travel plan. In this paper, we focus on introducing the tour planning system. The kernel of this system is a tour planning framework which directs users to clarify their special needs step by step. A behavior tracing and interest analysis program is standing behind. Based on the interest analysis result, the tour planning framework automatically evolves to become more adaptive to a particular user. In section 2, the proposed tour planning framework is introduced. The concept of our interest analysis model is explained in section 3 and how the analysis result impacts the framework is given in section 4. Finally section 5 concludes this study and provides a brief discussion about our future work.

2. Tour Planning Framework

When the idea of going somewhere to enjoy ourselves for a while comes into mind, it is usually very vague – we don't know exactly where to go, how to go, and what to do there. Typically, we think about it and find out some related information and try to make the idea clearer and clearer. Finally we make a solid plan and arrange the details of a trip. We propose to use a computer to simulate this process, called tour planning framework as discussed below. Through the interaction between a user and a computer, the system collects users' requirements and decisions, and creates a tour plan for the user. A tour planning framework is defined to model the process.

A tour plan includes 1) a city list that describes where to go, 2) means of transportations to take one from one city to another, 3) in each city, a detailed time schedule and a hotel or the like to stay at night. In order to get this detailed tour plan, three questions should be answered by the user – Where to go? How to go? And what to do? Figure 1 shows our proposed tour planning framework.

Step 1, a fuzzy intention of tour is got,

Step 2, the information of candidate cities is provided by the system and the user makes the decision where to go,

Step 3, the information about means of transportation is showed and the user decides how to go from one place to another,

Step 4, detailed information of each selected cities is provided and the user choose how to spend his (her) time in each city.

Step 5, a detailed tour plan is created finally.

The following example illustrates the idea of our model described above.

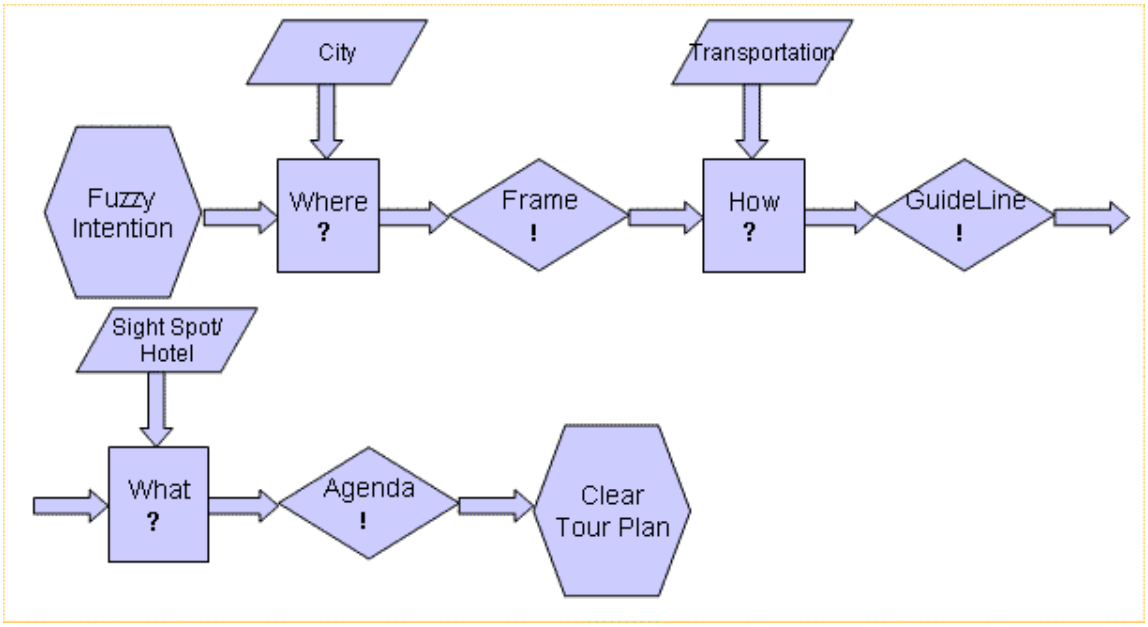

Figure 1. [Tour Planning Framework]

Case Study One

Step 1, the user decides that the journey starts from ChengDu and the intended cities are in the area of south west of China.

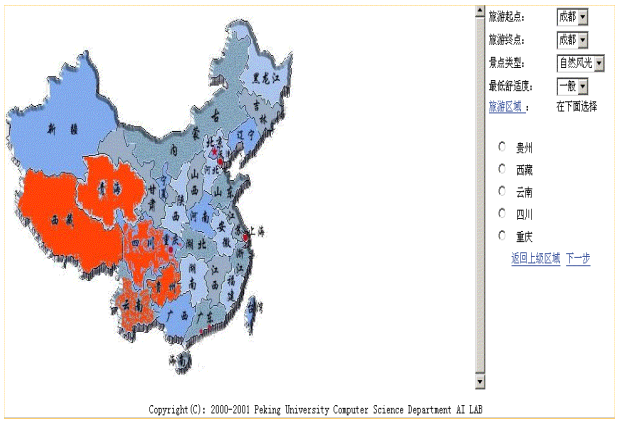

Figure 2. [Step 1]

Step 2, the system lists the candidate cities: "KunMing", "ChongQing", "EMeiShan", and "JiuZhaiGou", etc.

Figure 3. [Step 2]

Step 3, after browsing some information, the user narrows them down to "KunMing" and "ChongQing". The system then shows all available flights, buses (if any), trains that are available from ChengDu to KunMing and then to ChongQing. The user could choose one itinerary of 'flight SZ4415' from ChengDu to KunMing, and 'Train No.5600' from KunMing to ChongQing, and 'flight 3U422' from ChongQing back to ChengDu. In an ideal setting, these flight, train, and buses information are pulling from respective service provider real time, including their fares (discounts), availabilities, time schedule and changes, among others. Cost comparison can also be incorporated into this model, and new itinerary (say to visit ChongQing first, then to KunMing and back to ChengDu) may be proposed by the systems to save time and/or total trip cost.

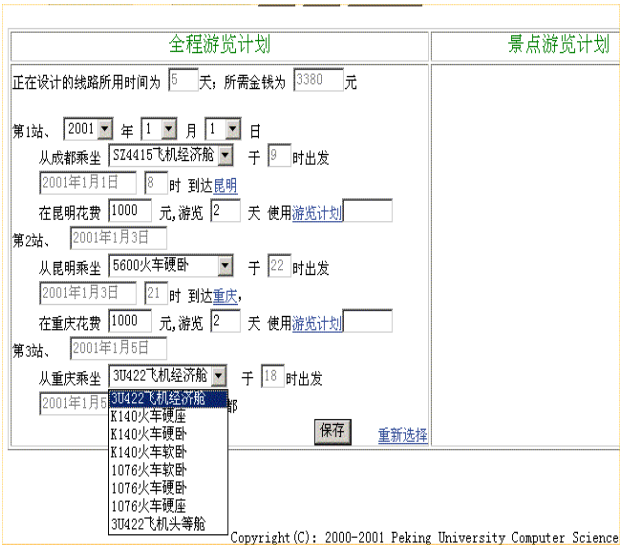

Figure 4. [Step 3]

Step 4, the user tells how long and how much he would like to spend in each city. Using these constraints, the system either automatically recommends some candidate agendas or makes the user design one himself.

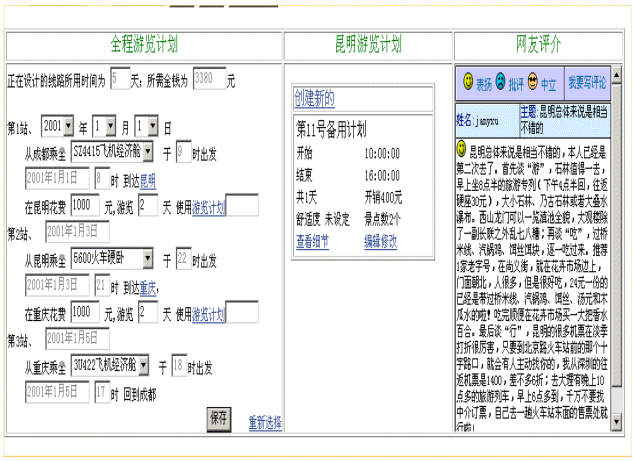

Figure 5. [Step 4]

Step 5, now a comprehensive tour plan is finally presented.

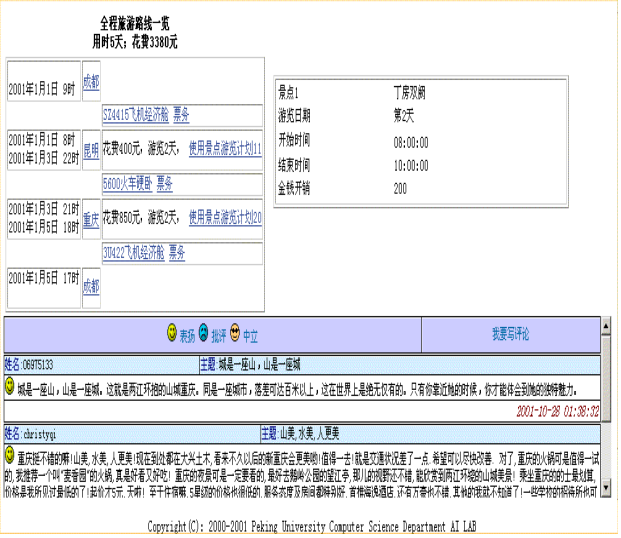

Figure 6. [Step 5]

3. User Interest Analysis Model

The proposed tour planning system aims at providing user a tool to design details of their own trips. A key to the success of this system is to provide appropriate information at the right time. It is expected that the system can become more adaptive to each specific user by integrating user's personal interest. In the system, a user interest analysis model is designed to monitor the user's behavior and get the user's interest based on his (her) behaviors. According to the user's interest, the system automatically filters the information provided to the user.

Figure 7 shows the relationship between the tour planning system and the interest analysis model which includes a Behavior Analyzer, a User Profile and a Rule-Based Filter. The Behavior Analyzer traces and analyzes the user's behaviors and stores the user's interest into the User Profile as its output. The User Profile records each user's personal interests and preferences. The Rule-Based Filter filters the information provided to the user according the predefined rules and user's interests.

3.1 Behavior Analyzer

The input of the Behavior Analyzer is the user's actions on the web pages (behaviors) and the output of it is the user's interests. What the Behavior Analyzer does is to map the actions to interest. So three questions should be answered: 1) How to denote the actions? 2) How to represent the interests? 3) How to do the mapping?

Based on the nature of web pages, user's actions to a

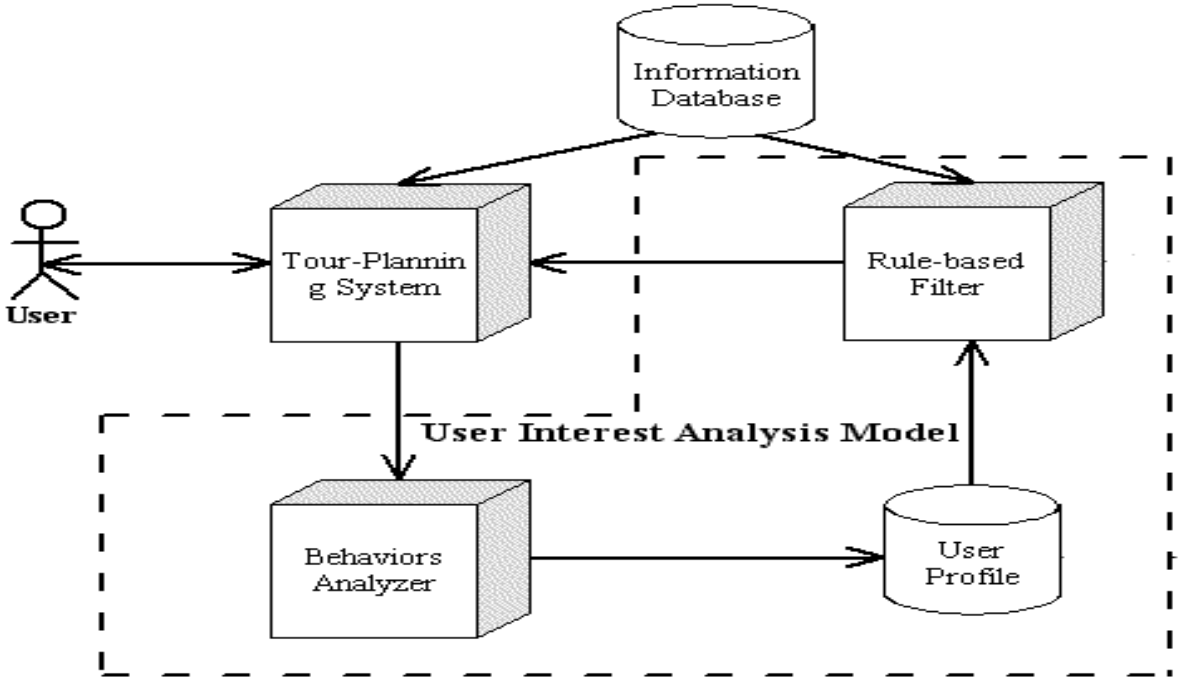

Figure 7. [Collaboration of the Tour Planning System and the User Interest Analysis Model]

page fall into two categories: entering texts into an edit widow or making a click (to hyperlinks, radio buttons, push buttons, etc). According to the context of the pages, an action list is predefined. Here we denote an action as $Action_i$ $(i=1, 2\ldots n)$.

User interests represent a user's preferences in doing a decision and they are domain dependent. In tour planning, the type of the sight spots, the available time span, and the budget limitation are all concerned factors for a user to make a decision. Here an impact factor is called an interest type and is denoted as $Interest_i$ $(i=1, 2\ldots m)$.

Here we denote a user as $User_i$ $(i=1, 2\ldots k)$.

The Behavior Analyzer does three things:

Record user's actions as $\{U_i, a_1, a_2 \ldots a_p\}$; where User i did the action $a_1, a_2 \ldots a_p$, where a_r belongs to $Action_r$ $(r=1, 2\ldots n)$.

Map each a_j against a predefined mapping table *Action-Interest (see Table 1)* to get a two dimensional interest table *User-Interest (see Table 2)*;

The A_1 in the table U-I is an instance of $Action_2$.

Sum up the points less than one type of interest; we will get the degree of how likely the user has that interest. This is denoted as Formula 1:

$$UI_i = \sum_{k=1}^{p} AI_{ki} \qquad (1)$$

Where UI_i represents the interest degree that a user has over $Interest_i$ and AI_{ki} is the cell at column i row k in Table 2.

3.2 User Profile

A User Profile is a table to record each user's personal interest. An example is given in Table3.

Table 1. [Action-Interest (A-I)]

	$Interest_1$	$Interest_2$	$Interest_3$	...	...	$Interest_m$
$Action_1$	1	0	1	0	…	0
$Action_2$	0	0	1	1	…	0
…	0	1	0	0	…	0
…	…	…	…	…	…	…
$Action_n$	1	1	0	1	…	1

Table 2. [User-Interest (U-I)]

	Action type	$Interest_1$	$Interest_2$	...	...	$Interest_m$
A_1	$Action_2$	0	1	…	…	0
A_2	$Action_5$	0	1	…	…	0
…	$Action_5$	1	0	0	0	0
…	…	…	…	…	…	…
A_p	$Action_2$	0	1	…	…	0

Table 3. [User Profile]

User	$Interest_1$	$Interest_2$	…	$Interest_n$
$User_1$	5	4	…	7
$User_1$	8	4	…	5
…	…	…	…	…
…	…	…	…	…
$User_n$	6	3	3	10

Synthesize table *User-Interest* using a predefined formula *F-1* to get a user interest vector $\{U_i, i_1, i_2 \ldots i_m\}$, where i_m represents how likely User i has interest of *Interestm*.

The number in the table A-I denotes whether an action contributes one point to an interest.

3.3 Rule-Based Filter

A Rule-based Filter filters the information that the system provides to the user. The filtering process is

conducted according to a set of predefined rules and the user's personal interests. A rule is something like:

IF $Interest_i$ > T **THEN** filter out contents of X(2)

T is a threshold and X is a specific topic.

How to define these rules and how to implement the Filter is still in working.

4. Evolution of the Framework Based on User Interests

The Intention Understanding Model described in Figure 1 in section 2 can be further generalized. As shown in Figure 8, a fuzzy intention can evolve into a clear intention through several rounds of interactions and through answering a series of related questions.

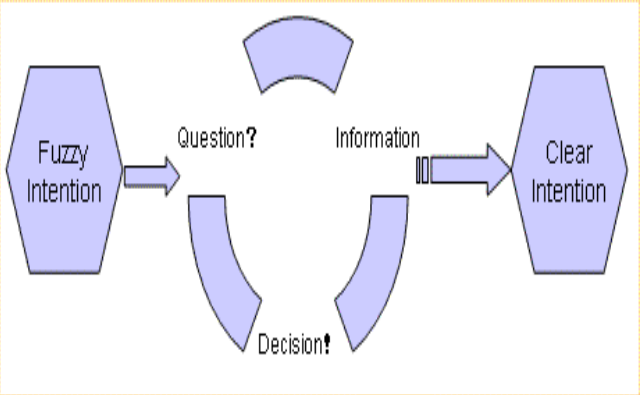

Figure 8. [Generalization of Figure 1]

At first, the information provided to user to help him make a decision is mostly selected based on domain knowledge. After a user having used the system for a while, the system can learn the user profile from its behaviors analyzing. Consequentially, the information provided will be more and more personalized. We call this the evolving of the framework, as shown as Figure 9.

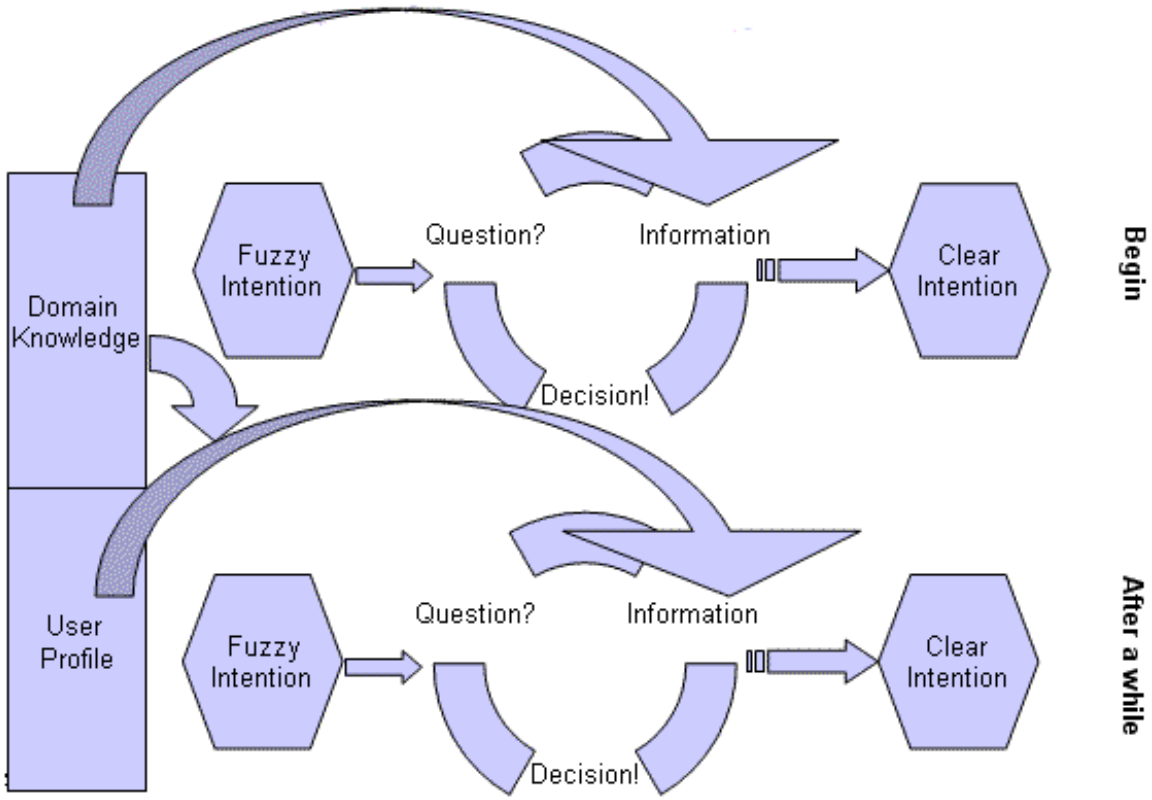

Figure 9. [The Evolving of the Tour Planning Framework]

5. Discussion and Future Work

The presented personalized tour planning system is a new type of web service which is a self-adaptive product designing. Using this system, users create tour plans of their own. Key issues involved in developing such a service are: 1) clearly define the scope of the service; 2) identify the supporting information; and 3) an appropriate framework to represent the designing process and the collaboration style between a user and a computer. The interest analysis component makes the system more adaptive to each specific user. Our future work will focus on tourism information storage standard and sharing and interest analysis model. Nowadays there have already existed many tourism related websites. How to make use of their information in our system and how to share and exchange information among these websites still poses a challenge. Meanwhile our interest analysis model still needs further work to achieve practically feasible/acceptable result.

6. Acknowledgments

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