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# System Architecture & Feature Design for Engineering a Web-based Travel Advisor System

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**Abstract**

Many Advisor Systems have been designed and developed to assist us in decision-making, each with their strengths and weaknesses. A popular type of Advisor systems is Travel Advisor systems that assist travelers in their travel arrangements. We have designed and implemented a Travel Advisor system to assist travelers, evaluating a number of factors after analyzing the features of other Travel Advisor systems. These factors are travelers' budgets, distance, their friends' interests, individual and group interests, dislikes, transportation mode and travel histories. We demonstrate the validity of the solution using case studies and usability testing results. In this study, our major goal is to measure the system's usability both with participants who previously travelled to the location and with participants who have never been there to investigate if familiarity correlates with positive rating of the system features. Our findings state that familiarity with the location correlates with positive rating of system's features.

Keywords: Advisor Systems; Travel Advisor Systems

## 1. Introduction

Comprehensive coverage of user requirements is necessary for making travel arrangements in a web-based travel advisor system. There are many options available on the Internet but research studies [1] [10] state that travelers are not satisfied with the current implementations yet. Travelers have various needs and expectations that need to be considered. For example, using current Travel Advisor applications, travelers can define their destination, arrival and departure dates to receive advice on their hotels and flights. However, they often need some other features to complete their search due to their budgets, interests and/or dislikes. In this paper, our aim is to provide a flexible software architecture for the comprehensive coverage of user requirements, offering a wide range of features in a web-based Travel Advisor. We also measure the system's usability both with participants who previously travelled to the location and with participants who have never been there to investigate if familiarity correlates with positive rating of the system features. Before a search, travelers are expected to fill in a user profile, entering a list of their interests, dislikes, and history of their travels to receive a customized list of suggestions. The system takes into account their constraints to increase user satisfaction. To compare and validate the solution to the existing systems, we conducted two usability studies, and provided two real scenarios to explain the problem. We explain the structure of the system and discuss the results of both usability studies in this paper.

## 2. Literature review

Travel Advisor Systems help users to arrange their travels based on their interests and constraints. Currently, they provide a limited number of standard features. For instance, some of them provide suggestions about only a particular place, or the others that provide a single service such as hotel-booking services. Therefore, users need to visit many websites to find the required information. They also need to match the collected information with their itineraries.

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Decision-making requires extensive amount of work and time. Usually decision makers have different constraints and need to deal with a large number of available options. Although there are many web sites available to provide travel related suggestions, none of them provide an accurate and customized suggestion and travelers still have to deal with "many-answers-problem" as stated in [2] and [3].

Providing travel suggestions is difficult, as many different criteria need to be addressed to satisfy travellers who have different desires. Let's study a real scenario, Jack lives in Sydney and is planning to travel to U.S. He has a limited budget, and there are many cities and places to visit. He uses various websites to get more information about the destination. After searching for a long time, he gets confused with a long list of places in every city. To make a decision, he needs to spend more time to search every specific location he will visit. Although he makes a smaller list of interesting places, summation of expenses shows he is over budget. He decides to use some of the Travel Advisor websites, but he finds out that some of these provide pre-defined packages that he is not fully interested in, while the others provide a long list of interesting places, which is overwhelming. If he were travelling with his family, he would have more difficulties in his travel arrangements, as every member accompanying him would have different interests.

Another example would be as follows: Sarah's small family is going to visit Hamburg, Germany on a limited budget. Sarah's main interests are sightseeing (particularly walking) and visiting the surrounding parks. Her husband is interested in sightseeing and arts. Their young daughter's interests are walking tours and swimming. They would start their exploration by using existing search engines but these would return a long list of results. This would make it difficult for them to select the best options and make a decision to satisfy the needs for all. As another option, they choose to use Travel Advisor websites but again they get a long list of results as well as a number of predefined packages that might be over their budget. In addition to these complexities, they are all interested in walking, but they cannot find any website to help them arrange their travel based on walking as their preference and there is no website that provides suggestions for a family, considering every members' interests in-group travelling.

Using these case studies we defined the features required for system development as follows:

- Dislike list
- Tour tagging
- Group travelling
- Travel mode
- Priorities (I care about)
- Customized map

### *A. Available Travel Advisors*

Many research studies have been conducted and many systems have been developed to provide customized travel suggestions such as Trip Advisor [4] that is not providing comprehensive customized suggestions or Agoda [5], which is limited to hotel suggestions, therefore users have to book their hotels in Agoda and use other websites to get travel suggestions.

Henly [11] also provides a list of the best eight travel websites, as follows: Adioso, Travellr, AirBnb, Goby, Gogobot, Hipmunk, Travellerspoint and Wanderfly. They provide different services and fantastic interfaces, but none of them solve the problems outlined in our case studies. Therefore, if a family is going to use any of these websites, they have to use many other websites as well to complete their information gathering and spend time on analyzing the collected information to find the best option. In some cases, while travelers are investigating the options available to make their decisions and return to the website to get the offer, the option is no longer available.

### *B. Available Recommendation Systems*

The recommender system developed by [6], aims to solve the information overload problem. The application uses multi-agents to support a large amount of information. Each agent has its own confidence degree that is based on user's rating. Once the users evaluate the recommended items, the system recalculates the confidence degree of agents.

As stated in [6] the good performance is due to the fact that agents have Knowledge Bases with previous history of the cases. The major weakness of the system is the confidence degree of the agents that is based on the feedback of users. Two issues here need special consideration:

The first issue is dealing with cold-start users to warrant the users not to be reluctant to rate the recommendations, since this would affect the agent's confidence degree and system's accuracy negatively. The second issue is that, the users of the system, especially those who are travelling to a place that previous users of the system have not yet travelled to may receive insufficient or inaccurate recommendations, as there might be no previous recommendations available. Agents may lack information as their knowledge is based on users' feedback and are not able to make assumptions. The

proposed solution in [7] has a similar problem, as there are no previous records for those users that are travelling to a city for the first time.

As mentioned above a common problem among travel recommender systems published online for the first time is the lack of travel records, as most of them are based on chronological information. Since it is difficult to provide accurate recommendations in this case, some websites use the geographical information provided by other websites such as Flickr. However, the information provided in geo tags is limited and as users tag the photos on Flickr, the information is not always reliable. Although there are various attempts to solve this problem, none of them is highly accurate. [8]

For example, [8] is based on geo tags of Flickr. Once a user visits a city and uploads the geo tagged photos of that city, the system would suggest the interesting places of the second city based on the geo tags of users who have similar interests and visited both cities. The first limitation of the system is, users should be familiar with accurate tagging and have already uploaded a number of photos otherwise they cannot use the system. The second limitation of [8] is that the system is limited to only ten cities worldwide.

A number of recommendation systems use GPS data to provide their suggestions. Hyoseok Yoon's system [9] is for social itinerary recommendation and is completely based on GPS data to provide its itineraries. Although nearly everyone has a cell phone but most travelers attempt to minimize their unnecessary costs of data roaming, using Internet for search would incur more undesirable costs.

Another similar system is [12] that offered its own wireless device to be used in attractive places. In spite of incurring costs, it would be questionable whether travellers would purchase and install the wireless device.

## 3. Proposed Solution

We have considered different aspects of travel arrangements and travelers' problems to provide a comprehensive solution to the aforementioned problems. Our solution consists of two parts, a comprehensive Knowledge Base, and an Inference Engine. Knowledge Base keeps information about users and cities such as, users' histories, interests, dislikes, occupations, interesting places, and the environmental information about the cities. The engine consists of four parts. The "Query Processor" which receives and processes users' requests, the "Information Collector" which collects the information from external websites and records it in the Knowledge Base. The "Rule Applier" and "Analyzer" using a shared algorithm work together to analyze the requests, rules and collected information to provide suggestions.

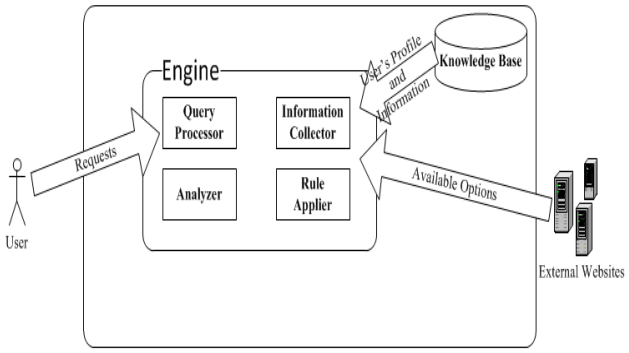


Fig. 1. System Architecture of FanOnTour

The role of "Query Processor" is to collect the provided information from users and store it in the Knowledge Base. Then, "Information Collector" collects the information, and provides it to "Analyzer" that analyzes the collected information and sends a request to "Information Collector" to collect the destination related information from the Knowledge Base and external websites, such as surrounding hotels, availability of flights and weather condition. Once all the required information is received, the "Analyzer" analyzes all the collected information and sends the results to "Rule Applier" to provide the suggestions. For instance, if the weather condition is not suitable to travel the user will be notified.

The system provides a search box to receive criteria to create user profiles. While creating user profiles, the system will ask two simple questions: "What are your interests?" "What are you not interested in?" Users may also provide their fellows' interests and dislikes in this query.

The "Rule Applier" considers all the received information and user's limitations in providing the suggestions; therefore if user has already created a profile, it would positively affect the suggestions. For example, system would ignore those activities that are already added to user's dislike list.

Knowledge Base supports the "Rule Applier". For instance, if a user is travelling to a city that is not popular in the season of travelling, the "Rule Applier" retrieves the information of other cities that are similar to the selected city. In this case, user would not need to check the weather or popularity of the destination in time of travelling.

The aim of the solution is to minimize the usage of other websites, such as weather forecasts, hotel or flight advisors and travel forums. Returning to the Sarah's family case study, Sarah signs up to the system and add every member of her family's interests and dislikes. Then, she enters the details of destination, the system

receives the input, collects and analyzes the related information, and provides the most appropriate suggestions to satisfy the expectations of every member of the family. The Inference Engine categorizes the items to suggest into groups on the bases of interests, considering their price and distance to location. If Sarah has 3 interests such as choice21, choice24 and choice31. Items to fill in these fields have attributes such as price and distance to origin such as item1 (0, d), item3 (5, d), etc. Calculating their distance to origin, these items' attributes are filled in, such as item1 (0, 10), item3 (5, 30), etc. Evaluating these options, the system categorizes choice21 (item3, item10), choice31 (item1), choice24 (item2, item14). Then, the system sorts these on the basis of occurrence to make suggestions.

## 4. Demonstration of Solution

To validate the solution a system prototype has been designed and implemented. Figure 2 demonstrates the landing page of the prototype. Users may use the provided search box to search for the suggestions; most parts are the same as other Travel Advisor websites, except for the last two parts that ask for "Travel Mode" and "Type of Considerations". By choosing any option of "Travel Mode" users would provide their main mean of transportation. Calculation of travel destination and durations will be based on this section.


Fig. 2. Travel Details

Another feature is "I care about". Every traveler may care about different factors. In this section their limitations will be asked such as the price they are willing to pay as well as the distance. Those who need to consider both distance and price or have not any limitations may choose either "Price+Distance" or "High rated" options. Once the users provide their limitations, the application will provide the customized suggestions.

Comprehensiveness of the suggestions is based on the information provided in the search box and whether users have built their personal profile. Creating a profile is simple. They are just asked to provide their interests and dislikes. For example, if someone is interested in Sports, sport related activities would be in high importance for the application. On the contrary, if someone has added sports to his/her dislike list, sport related activities would not be provided in the suggestions. Figure 3 shows a list of suggestions.


Fig. 3. The suggestions of FanOnTour

As shown in figure 3 the total amount of traveling is provided at the end of the table, as the user has chosen "High Rated" option in the search box, the application ignores the prices and provides an expensive list of suggestions.


Fig. 4. Customized map shows the location of suggestions


Fig. 5. Customized map shows the location of hotel

## 5. Validation of Solution

Two separate groups of 20 participants participated in experiments to test the system. All participants had basic computer skills and have already used at least two Travel Advisors. London was randomly selected as the destination. The goal of the experiments was to investigate if familiarity correlates with positive rating of the system features and to measure the system's usability both with participants who previously travelled to the location and with participants who have never been there. Those participated in the first usability testing have never travelled to London while the others participated in the second usability testing have travelled to London before. Both usability tests were conducted in two phases: First phase with existing Travel Advisor websites and second phase with FanOnTour.

To conduct both testing, all participants have been asked to choose London as their destination, ignore the flight and just look for the hotel and interesting places to see around.

### *A. First Phase*

Participants had 20 minutes to use their favorite websites or search engines to search for places of their interest in the destination, London. Most of the participants started their search by looking into a number of Travel Advisor websites and at the end, used a search engine to look for additional places.

Main observations from the first phase are noted as follows:

- 50% of participants tried more than 3 Travel Advisor websites.
- 5% of participants in the first testing requested to call their friends to ask for their advice on useful websites.
- 80% of participants asked for more time to look into results for other available options and believed that there might be more options available.

### *B. Second Phase*

Participants were asked to use the FanOnTour system. They were requested to create their profile and ask the system to come up with suggestions for the interesting places to visit. To create their profile they were asked about their interests and items that they disliked for all members of their group.

Similar to the previous phase, they were asked to choose London as the destination, ignore flight details and look for the hotel and interesting places. All participants used the same computer to complete the testing.

### *C. Results and Comparisons*

In the 1st Usability Testing, the average percentage of satisfaction on system's suggestions was 89.25% in Phase 2 vs 56.65% in Phase 1. In the 2nd Usability Testing, the average percentage of satisfaction on system's suggestions is 92% in Phase 2 and 60% in Phase 1. No matter if the users have had travelled to the location before; FanOnTour had a better performance than existing Traveler Advisors (above 32% for all travelers).

Users were also asked to rate the features of the system and questions asked by the system during testing. The average rating of features for FanOnTour was 93.75% in the 2nd Usability Testing vs 89.5% in the 1st Usability testing. In both usability tests, those who were not satisfied with the FanOnTour features were complaining about the lack of transportation mode in Travel mode, and not showing the routes on the customized map.

As seen in table I, and II, the average rating of simplicity of system is 100% in 2nd Usability Testing 98.25% in the 1st Usability Testing, although in both testing cases, users thought that the interface could have been better designed.

TABLE I. RESULTS OF THE FIRST USABILITY TESTING ON FANONTOUR

| Participants Unfamiliar-to-location | Suggestions (%) | Features (%) | Simplicity (%) | Recommend to other? (N=0,M=50, Y=100) |
|---|---|---|---|---|
| 1 | 95 | 90 | 100 | 100 |
| 2 | 85 | 90 | 100 | 100 |
| 3 | 100 | 100 | 100 | 100 |
| 4 | 80 | 85 | 100 | 100 |
| 5 | 100 | 100 | 100 | 100 |
| 6 | 100 | 100 | 100 | 100 |
| 7 | 85 | 80 | 100 | 100 |
| 8 | 100 | 100 | 100 | 100 |
| 9 | 60 | 80 | 95 | 0 |
| 10 | 95 | 100 | 100 | 100 |
| 11 | 100 | 100 | 100 | 100 |
| 12 | 90 | 80 | 90 | 100 |
| 13 | 100 | 100 | 100 | 100 |
| 14 | 100 | 100 | 100 | 100 |
| 15 | 90 | 95 | 100 | 100 |
| 16 | 75 | 60 | 90 | 100 |
| 17 | 45 | 30 | 90 | 0 |
| 18 | 90 | 100 | 100 | 100 |
| 19 | 100 | 100 | 100 | 100 |
| 20 | 95 | 100 | 100 | 100 |
| Total | **89.25** | **89.5** | **98.25** | **90** |

TABLE II. RESULTS OF THE SECOND USABILITY TESTING ON FANONTOUR

| Participants Familiar-to-location | Suggestions (%) | Features (%) | Simplicity (%) | Recommend to other? (N=0,M=50, Y=100) |
|---|---|---|---|---|
| 1 | 100 | 100 | 100 | 100 |
| 2 | 90 | 95 | 100 | 90 |
| 3 | 90 | 90 | 100 | 90 |
| 4 | 90 | 100 | 100 | 85 |
| 5 | 100 | 100 | 100 | 100 |
| 6 | 75 | 80 | 100 | 80 |
| 7 | 80 | 90 | 100 | 90 |
| 8 | 90 | 100 | 100 | 90 |
| 9 | 90 | 90 | 100 | 90 |
| 10 | 80 | 80 | 100 | 90 |
| 11 | 100 | 100 | 100 | 100 |
| 12 | 90 | 90 | 100 | 100 |
| 13 | 95 | 90 | 100 | 90 |
| 14 | 85 | 90 | 100 | 80 |
| 15 | 90 | 90 | 100 | 85 |
| 16 | 100 | 100 | 100 | 100 |
| 17 | 100 | 100 | 100 | 100 |
| 18 | 95 | 100 | 100 | 90 |
| 19 | 100 | 100 | 100 | 100 |
| 20 | 100 | 90 | 100 | 90 |
| Total | **92** | **93.75** | **100** | **92** |

As seen in table I, and II, in the 1st Usability testing 90% and in the 2nd Usability testing 92% of participants declared that they would recommend the FanOnTour system to others. The reason for the remaining 10% and 8% of users not recommending the system was relevant to either their level of satisfaction on suggestions, and/or not trusting the application, and/or not supporting public transportation as they believed that would highly affect the travel budget.

As seen in Table III, the system's performance is even perceived better by the users who have travelled to the location before.

TABLE III. COMPARISONS BETWEEN THE TWO USABILITY TESTING STUDIES

| Usability Testing | System Suggestions | System Features | System Simplicity | Recommendation |
|---|---|---|---|---|
| 1 | 89.25 | 89.25 | 98.25 | 90 |
| 2 | 92 | 93.75 | 100 | 92 |

Results suggest that participants in familiar-to-location group have greater appreciation to the features of the travel advisor system FanOnTour. This may be due to the fact that location familiarity has facilitated the mental representations of the places to visit suggested by the system. This supports the previous studies stating that familiarity correlates with more positive responses. For example, Sanabria et al [13] evaluated a group of subjects' level of familiarity with images and headlines. In the main experiment, a different group of subjects rated their pleasure and arousal to, and familiarity with, image-headline combinations using The Self-Assessment Manikin (SAM) scale. Their results showed a high correlation between familiarity and pleasure. They suggested that in the case of natural-scene ads, familiarity with image-headline combinations might increase the pleasure response to the ads.

## 6. Conclusion and Future Work

Considering current solutions, travelers still deal with a long list of related or irrelevant suggestions which makes the travel arrangement a tedious and time consuming task. Analyzing the limitations and strengths

of current solutions helped us provide a comprehensive solution to cover the limitations of existing Travel Advisors.

Our solution provides novel features to assist users. The system has been tested twice with users who did not travel to the selected destination before as well as users who traveled to the location before. In both usability-testing studies, the level of satisfaction was high, but even higher when participants were familiar to the location to visit. The results support the previous study by Sanabrie et al [13].

The testing also revealed that considering the public transportation is an inevitable feature to add for a Travel Advisor application. Therefore, supporting public transportation is our main aim in future along with other features, such as Weather Forecasting, Mobile Application and Age Range features. Weather Forecasting feature would provide weather forecast in the destination and enable users to arrange their travel, based on their preferred weather conditions. Another feature worth considering is the Age Range of travelers. Using this feature traveler may search for popular cities based on their age range, or ask questions such as "where my age group or gender goes with similar limitations". We are also planning to develop the application on mobile platforms.

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