Development of an intellectual module for selection of places to travel in the virtual assistant system for planning trips

Natalia Yanishevskaya, Larisa Kuznetsova, Arthur Zhigalov, Denis Parfenov and Irina Bolodurina

Orenburg State University, Orenburg 460018, Russia

E-mail: prmat@mail.osu.ru

Abstract. Often it is difficult for the tourists to determine their preferences and choose destinations for the trip. To simplify the planning of the upcoming vacation, you can use recommendation systems that, based on a survey of users, determine the most preferred places to visit. Also, the key to a successful trip is a well-planned route. The developed travel planning system combines both of these aspects: the intelligent module will recommend the user sights and interesting places to visit based on a small survey, after which the optimal route planning module build the schedule of their visit. In this article, the authors considered in detail the approach to the construction of individual user recommendations highlighted the main characteristics inherent in each region of the Russian Federation and built a decision tree.

1. Introduction

Nowadays, more and more people prefer to plan their travel. This phenomenon is due to the possibility of obtaining maximum impressions from the trip, budget savings, and also gives the tourist the right to choose the duration of the trip both in general and certain areas.

Thus, according to the research conducted by the Analytical center NAFI in March 2019, over the past year, more Russians have begun to travel both domestically and abroad. The growth was primarily due to those who prefer to plan their holidays, while the number of clients of travel agencies has not changed. Since 2018, the share of Russians who prefer to organize their vacation has increased-to book tickets (from 28% to 34%) and rent housing (from 26% to 32%). The share of those who will apply to a travel agency for the organization of the upcoming vacation has not changed: so will every third Russian (29%). Young and middle-aged people (up to 44 years) often prefer to organize their holidays themselves: buy tickets (46%) and book accommodation (45%). Among people over 60, only one in ten act like that (15% buy tickets, 12% book accommodation). Residents of Russian capitals plan holidays on their own less often than residents of other cities (23% vs. 34% rent housing, 28% vs. 35% book tickets), but more often use the services of travel agencies (37% vs. 30%).

In these conditions, it becomes relevant to develop an intelligent virtual assistant that helps based on a small survey of the user to provide him with information about the most suitable travel directions, as well as to make the optimal route in terms of duration of their visit.

In this study, the focus is on the methods of selection of virtual assistants’ intelligent module attractions and places of rest, based on which the optimal route is built. An approach based on the using of a production model of knowledge is proposed.
The article is organized as follows. In the section 2 provides basic information about the intelligent virtual assistant. Section 3 describes the results of a literature review that looks at different approaches to automating the travel destination selection process. Section 4 contains the basic idea of the intelligent module of the virtual assistant, which is aimed at the selection of attractions and places to visit, the most suitable for the needs of the tourists. Section 5 describes the results of the study.

2. Main idea
When organizing a trip, it is important to plan every day of a tourist trip in order to have time to visit the maximum possible number of interesting places. Each trip is limited by the total number of days, money opportunities and the desire of the tourist to visit various places and attractions of the regions of the Russian Federation. It is important to provide the tourist with information about the most satisfying destinations, existing in them places for recreation, sightseeing and entertainment, as well as take into account the way to move between settlements and the time allotted to the traveller for the whole holiday.

In order to form a transport and logistics structure, the following tasks are solved within the framework of the project:

- identification of possible tourist destinations based on user preferences;
- time resource planning.

Let's take a closer look at the work of the virtual assistant.

At the initial stage, the system identifies areas most suitable for the user preferences based on a small survey, which consists of the following items: selecting the place of departure (arrival), definition of purpose of trip (beach vacation, skiing and snowboarding, history and culture, nature), the choice of transport to move from one place to another (personal car, bus or train), date of departure and return, and range of budget. Based on the answers, the virtual assistant offers a choice of several settlements and a list of attractions and places of interest in them with a small description and photos. The user can choose the most favorite places for further travel, as well as specify the priority of their visit. If there are no priorities, the system will select the locations based on user ratings. The work of the intelligent module of the virtual assistant is finished. In more detail the module of selection of places for travel is considered in Section 4 of this article.

The module for constructing the optimal route will specify the user the time at which he expects to start and finish his tourist day, as well as the time for the inspection of each attraction. After that, the system will build the best route for each day of travel, taking into account the time to return to the hotel from the last place of visit.

3. Related work
The article [1] addresses the problem with the proposed QPSO and QICE based collaborative filtering recommender system through an efficient user clustering mechanism. Authors have attempted to develop a hybrid user clustering model for neighbourhood selection problem of RSs. The experiments conducted on the two large-scale real-world datasets and the obtained results portray the performance of the proposed QPSO and QICE based CFRS. The proposed recommendation approaches outperform the standalone recommendation approaches with the accurate recommendation in terms of Hit-Rate, Precision, Recall, F-Measure, and Accuracy.

In [2] the expert system of support of the tourism sector of Turkey is considered, with the help of which travelers can choose the most satisfying their interests’ holiday destinations. The system is developed based on text mining using the K-Means++ clustering algorithm (an extension of the k-means method).

The study of R. Chauhan [3] describes the design and development of an expert tourist information management system. This system provides recommendations on the appropriate travel schedule that best suits the user's travel preferences, taking into account its time budget and money budget. The q-learning algorithm serves as a mathematical basis for building recommendations. Also, the system has
an intelligent module Travel Route, designed to find the shortest path between two cities selected by the user.

In [4] authors designed and implemented a prototype of a tourist expert system with a knowledge base containing more than 20 cities and 150 production rules. The system allows choosing the direction of travel, the most relevant to the most important needs of the tourist. The authors propose a new pseudo-fuzzy counter (PFC) for adding fuzzy facts and rules to the system based on evolutionary algorithms.

In [5] presented the assistant of choosing the direction of travel (Itinerary Selection Assistant (ISA) system), which, using the candidate-evaluation model (CEM) based on user preferences, allows you to plan the tourist route of travel.

The authors of the article [6] proposed an intelligent module integrated into the tourism web site which helps the user to find the most suitable for their preferences of places on a trip to Turkey. The intelligent system makes recommendations for travel planning based on the Case-based reasoning algorithm, which is a method of solving new problems based on already known solutions. The jacquard coefficient (Jaccard index) was chosen as the similarity coefficient.

Authors of the study [7] offer a system of personalized recommendations for the selection of travel destinations based on user interaction with the system and heterogeneous information about tourist trips. In the first stage of building recommendations through multi-user exchange, which acts as a collective intelligence to ensure the reliability of information from social networks are aggregated heterogeneous tourist travel data. The information is then filtered out of the noisy data and structured. After that, with the help of personalized attraction similarity (PAS) model, which combines travel information and tourist reviews, the user, receives recommendations on the most suitable travel destinations. Also, the system takes into account contextual information for more accurate recommendations.

This study is aimed at developing a software-algorithmic solution for constructing the optimal route between the attractions and places of interest for the traveler [8], selected by the intelligent module. This module is based on the production model of knowledge representation.

4. Intellectual module for selection of places to travel
The main component of the system is the intelligent module. The architecture of intelligent module for selection of places to travel is shown in figure 1.

![Figure 1. The architecture of intelligent module for selection of places to travel.](image)

Many regions of Russia have a rich tourist potential, represented by a variety of natural, cultural and spiritual treasures, developed infrastructure, a variety of tourist routes. A wide range of different
destinations allows tourists to enjoy their holidays according to their taste and preferences, whether it is the scenery of wildlife or megalopolises with their attractions.

Thus, tourism in the Russian Federation can be divided into the following categories:

- beach holiday;
- skiing and snowboarding;
- extreme sports holidays;
- shopping;
- treatment/motels;
- history and culture;
- cruise holidays;
- nature.

The most comfortable for the user climate can also help to narrow the area of suitable places to travel. All climatic zones in Russia can be divided into 3 groups:

- subtropical/tropical climate;
- temperate climate;
- subarctic climate.

The average cost per day of stay in the region is within the following limits:

- to 1500₽;
- from 1500₽ to 3000₽;
- more than 3000₽.

Mode of transport, which can be reached from one point to another:

- a car;
- a bus;
- a train.

Suppose there is a data set (a fragment is presented in table 1), containing a list of subjects of the Russian Federation, as well as available in their recreation and climate information, characterizing each subject.

| №  | ID  | Name of region          | Beach | Skiing & snowboarding | Extreme sport | Shopping | Treatment/motels | History and culture | Cruise | Nature | Tropical/subtropical | Temperate | Subarctic | Up to 1500₽ | From 1500₽ to 3000₽ | More than 3000₽ | Car | Bus | Train |
|----|-----|-------------------------|-------|-----------------------|---------------|----------|-----------------|---------------------|--------|--------|---------------------|-----------|-----------|-------------|------------------------|-----------------|-----|-----|-------|
| 1  | 22  | Altai Krai              | 1     | 1                     | 1             | 1         | 1               | 1                   | 1       | 1       | 1                   | 1          | 1         | 1            | 1                       | 1               | 1   | 1   | 1     |
| 2  | 28  | Amur Oblast             | -1    | 1                     | 1             | 1         | 1               | 1                   | 1       | 1       | 1                   | 1          | 1         | 1            | 1                       | 1               | 1   | 1   | 1     |
| 3  | 29  | Arkhangelsk Oblast      | 1     | 1                     | 1             | 1         | 1               | 1                   | 1       | 1       | 1                   | 1          | 1         | 1            | 1                       | 1               | 1   | 1   | 1     |
In this table, the figures indicate the presence of a particular feature in a particular region of the Russian Federation, where "-1" is absent, "1" is present.

The intelligent module of the virtual assistant consistently asks questions to the user and, receiving answers to them, filters the initial list of regions of the Russian Federation, thus leaving the most suitable places for visiting for the user's requests. For each question, the user can give a specific answer or indicate that this criterion can be ignored when creating a recommendation.

To implement the problem of choosing a place of rest according to user-defined restrictions formed on the basis of answers to questions, the decision tree algorithm ID3 is selected. A fragment of the resulting decision tree is shown in figure 2.

![Decision Tree Diagram]

**Figure 2.** The fragment of the resulting decision tree used to select a holiday destination.

The resulting decision tree can significantly reduce the uncertainty in the selection of suitable holiday destinations for tourists, taking into account their individual preferences.

5. Conclusion

The use of the intellectual module for selection of places to travel in the virtual assistant system for planning trips allows you to automate the process of travel planning. The developed software-algorithmic solution helps to determine the most suitable direction of travel for the user taking into account financial, time, climatic, transport and other restrictions. The built module is planned to be further integrated with GIS services for visualization on an interactive map of specific proposals and detailed planning of recreation places.
Acknowledgments
The study was conducted with the support of the Ministry of Education of the Orenburg region in the framework of the research "Intellectual virtual assistant for planning trips to the sights of the Orenburg region" (project no. 3 on 14 August 2019).

References
[1] Logesh R, Subramaniyaswamy V, Vijayakumar V, Gao X-Z and Indragandhi V 2018 A hybrid quantum-induced swarm intelligence clustering for the urban trip recommendation in smart city. J Future Generation Computer Systems 83 653–73
[2] Dogan Y and Kut A 2010 An Expert System for Summer Tourism in Turkey by Using Text Mining and K-Means++ Clustering (ICT Innovations)
[3] Chauhan R 2010 An expert system for tourist information management. J. International journal of Computer Science and Communication 1.2 181-83
[4] Khakzad H and Shirazi H 2012 Tourism expert system with clips using PFC The 16th CSI International Symposium on Artificial Intelligence and Signal Processing (AISP 2012)
[5] Shi R 2008 An adaptive travel assistant itinerary selection under fuzzy user preferences Conference on Human System Interactions
[6] Büyüközkan G, Ergün B 2011 Intelligent system applications in electronic tourism. J. Expert Syst. Appl. 38 6586-98
[7] Shen J, Cheng D and Xinbo G 2016 Attraction recommendation: Towards personalized tourism via collective intelligence. J. Neurocomputing 173 789-98
[8] Bolodurina I and Parfenov D 2017 The optimization of traffic management for cloud application and services in the virtual data center. In: Proc. of the International Conference on Parallel Computing Technologies (Springer, Cham) pp 418-26