



MOBILE TOURIST INFORMATION SYSTEM WITH SAFETY RECOMMENDER COMPONENT

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Abstract

The authors suggested and described the architecture of the mobile tourist information system "Mobile information assistant of the tourist" (MIAT), that differs from existing analogs by the presence of user individual characteristics analysis module (character type, age, gender, education, personal preferences, etc.) in this work. The authors have developed a method of dynamic multimedia excursion guidance of tourists, which provides synchronization and playback of personally selected multimedia information in accordance with the planned route. This investigation presents the functional and architectural features of system "MIAT" safety recommender component, the main feature of which is to generate the list of safest tourist destinations on the selected travel period for the user, and recommendations on the potential hazards and methods of overcoming them if the user chooses to visit tourist destination, that is characterized by a high probability of dangerous situations. The component produces a forecast of natural disasters based on Big Data, Data Mining and cluster parallel calculations.

Keywords: mobile information system, tourist information system, information technology, big data, ANFIS, data mining.

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1 INTRODUCTION

Modern community rapidly gets closer to new high information technology development level. The use of mobile computing devices such as smartphones and tablets to access the Internet

has got to the level when it accedes the number of personal stationary computers that are used for the same purpose. According to eMarketer research, the overall number of mobile users of the Internet acceded the number of 134 devices in 2013 (eMarketer, 2015). In 2019 it will be twice higher than the number of users of stationary computer devices (eMarketer, 2015).

Tourist sphere is the area, that today for complete functioning and effective development badly needs up-to-date mobile information technologies that will be able to influence as individual tourist behavior as the whole sphere.

Mobile personal information systems help and support a tourist while planning the trip or traveling appear in the market of modern information technology applications.

One of the most neglected by information technologies but very important problem that tourist faces while traveling is safety. There is a lack of attention in up-to-date developments to the question of ensuring security to individual travelers (Savchuk & Pasichnyk, 2016).

2 THE ANALYSIS OF INFORMATION SOURCES

Tourist area brightly demonstrates high potential in using information technologies (Northern Ireland tourist board, 2012). The software developed to give personalized support to tourist during his trip have gained the largest distribution.

There are several examples of mobile trip planners.

The application called voyager: route planner is developed to help tourists to plan an optimal route to travel between several points of interests (poi) of the journey. The system users are travelers that visit different excursion sights, researches that plan car trips, companies that fulfill shipment and different transportation (for example, delivery services or passenger transportations). The main feature of mobile application voyager is easiness and convenience of using (Sensis, 2015).

That application that gained high popularity in the branch of trip planning is ViaMichelin. This software has the following functions: locating the user device, different types of maps (Michelin

maps, lite maps and sky maps), quick formation of the route between several points of interests according to the chosen transport type, displaying of several routes, counting indicative duration of the trip taking into account up-to-date data on traffic jams and the distance between poi, counting the cost of the trip, taking into account toll roads, average fuel value and transport type. The system provides the user with information on the location of tourist sites, catering, accommodation and so on (ViaMichelin, 2018).

Currently, in the branch of trip planning, topical application Route4me is topical software tool. It works under the Android operating system. The feature of this application is the possibility of route forming taking into account an unlimited number of target points (Route4Me, 2018).

A popular topic of researches is the automatic formation of personalized travel routes, that includes not only planning of the best route between multiple target points but also suggesting on the choice of various tourist facilities, places of accommodation and meals for each individual tourist.

A powerful application to plan a trip is TourPal. The software tool gives the user ample opportunities for travel planning and formation of certain tourist destinations with regard to personalized information about the user. The application provides information about tourist sights, places of accommodation and catering, guidance on choosing tourist facilities (TourPal, 2017).

Modern and popular mobile application for planning travel routes is a software tool "Trip planner", created by Ukrainian developers. The system allows users to create travel routes with a navigation function. Its feature is saving chosen routes. During the formation of the tourist route, the choice of appropriate transport solution is considered (TourPal, 2017).

Consequently, the market for mobile applications for personalized planning and maintenance of trips intensively develops. Mobile route planners are gaining popularity and may offer the user a variety of services. However, as a result of the analysis of information technologies that are oriented toward planning travel routes had

identified a number of problems that still need to be addressed. In particular:

- creation of personalized travel routes based on age, occupation, marital status and interests of the user;
- creation of personalized routes for family trips, taking into account the individual characteristics of each tourist;
- ability to edit and change the route during its realization;
- providing user security recommendations.

3 MOBILE INFORMATION ASSISTANT OF THE TOURIST. FUNCTIONAL AND ARCHITECTURAL FEATURES

The authors developed an innovative technological project of intellectual information system "Mobile Information Assistant of the Tourist" (MIAT) where an integrated mobile software and algorithmic complex next-generation prototype is worked out (Pasichnyk & Yehorova, 2015).

MIAT is a software and algorithmic with quite a complex structure. It involves the use of a wide range of information resources (databases and knowledge bases) and powerful mathematical and algorithmic software. Thus, the main end-user of the system hardware is a powerful mobile device with GPS antenna and the ability to connect to the Internet.

The main users of the system are the tourists, but there will be provided the ability to support the family and group tours taking into account the individual characteristics of each traveler.

The system will have very complex and extensive architecture and require considerable technical and information resources. Its main components are the database and knowledge base, analysis of the personal characteristics of the user, navigation and the "multimedia guide" mode that takes into account the dynamic characteristics of tour routes, planning travel routes, calculation of the budget, generating recommendations on selection of a tourist destination according of it safety features, backup of habitats and transport and others.

4 SAFETY RECOMMENDER COMPONENT

An important component of the system "MIAT" is the subsystem "Safe Tourism". Its main function is to determine the level of danger in passing tourist route and generate recommendations to the user to ensure his/her safety during the planned trip (Vykylyuk & N.M, 2009).

The functionality of safety component of MIAT system (Savchuk V. , 2016):

- determination o level of the danger:
 - determining the type of socio-political situation on the territory of tourist destination;
 - determining the level of the natural dangers according to the chosen period of time;
 - determining the tourist popularity of destination according to the season;
- generating recommendations to the user:
 - generating recommendations on visiting of one or another tourist destination in a preplanned period of time;
 - generating recommendations on behavior and social communications while staying in concrete country or region;
 - generating recommendations on obligatory items to take on the planned trip.

Subsystem takes into account factors that could affect the growth of tourist safety in selected regions, namely natural, technological, socio-political factors, living conditions and nutrition, and more. Natural subsystem determines the level of dangerous situations powered BigData, DataMining cluster and parallel calculations (Vykylyuk Y. I., 2010A) (Vykylyuk Y. , 2010B) (Tkachenko, 2006) (Vykylyuk, Ostafiychuk, & Uhryn, 2007) (Vykylyuk & Hats', 2011) (Vykylyuk & Hats', 2009) (Vykylyuk & Artemenko, 2010) (Radovanovich, et al., 2014).

The architecture of the subsystem is multimodal and branched (Savchuk V. , 2016).

The main structural components (modules) of subsystems are (figure 1):

- "Determining the level of risk" is a component of the safety recommender subsystem that is

responsible for the analysis of natural, technological and socio-political situations in the selected time period, assessment of the attractiveness of the territory and the current state of tourism infrastructure in the region. The component takes into account both current and archived data to analyze seasonal hazards (rainy season, drought, sandstorms, etc.).

component extracts archived weather data according to the selected region. All found information is saved into the database "Safety tourist."

"Generating recommendations" - is an important component that forms the security recommendations based on information found by previous components.

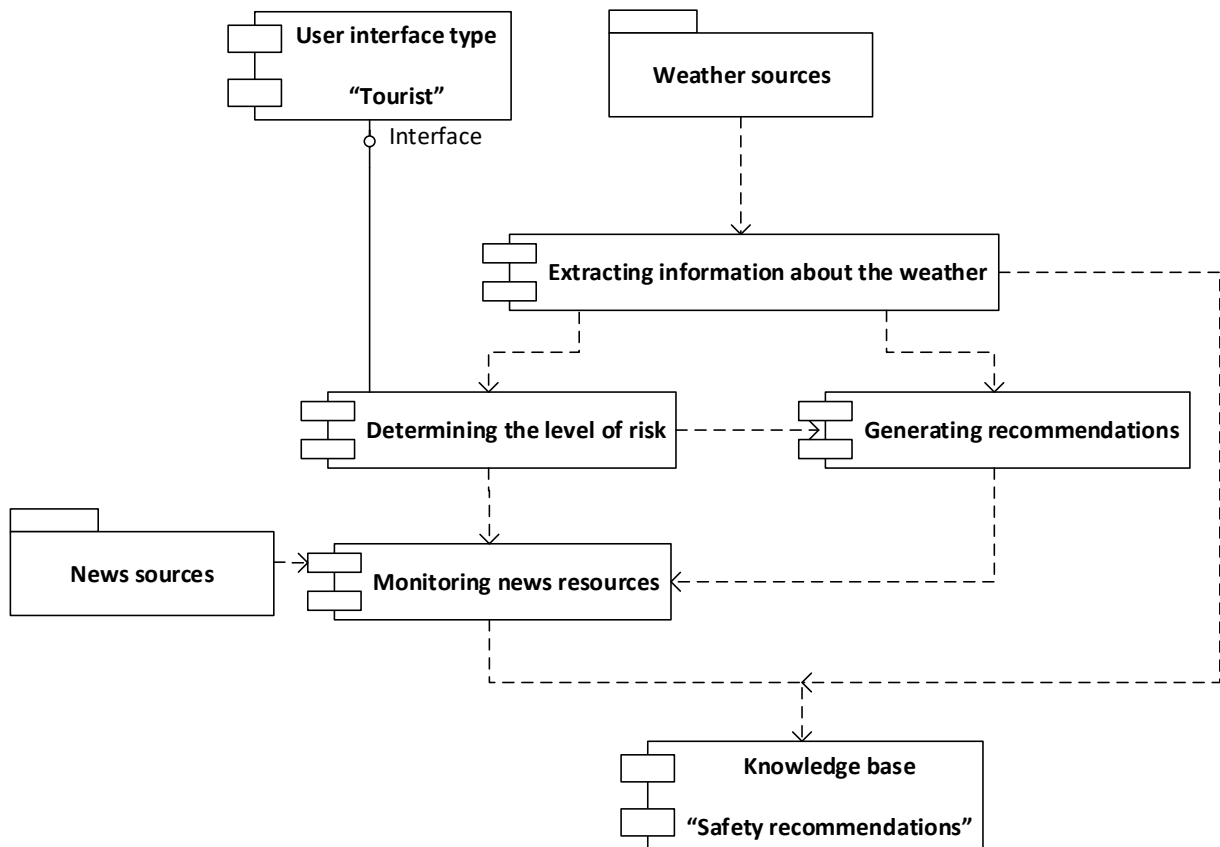


Fig. 1. The architecture of the subsystem "Safe Tourism"

"Monitoring news resources" is responsible for searching an information in world news internet resources. The component is seeking information about current world events, such as natural, technological and socio-political situation. The search is conducted for keywords that are available in the database, such as "blizzard", "storm", "fire", "bang", "terrorist act", "victim", and others. The results are saved into the database "Safety tourist".

"Extracting information about weather conditions" is responsible for searching for information on the weather forecast for the selected period of weather internet resources. Additionally, the

5 CALCULATION OF THE TERRITORY ATTRACTIVENESS

The Gauss membership function under fuzzy logic theory was used to determine the terms of linguistic variables x_1, \dots, x_{14} and the coefficient of historical and cultural attraction. Parameters of membership functions and production rules were formed with experts from Department of Tourism of Chernivtsi Regional State Administration.

The seasonal opportunity of rest $H(t)$ was determined using statistical reports (Tkachenko, 2006).

The number of tourists interested in some form of recreation as a percentage of the total mass of potential tourists C_i was defined with marketing research (Vykylyuk, Ostafiychuk, & Uhryn, 2007).

Table 1 Attractiveness of TRO Chernivtsi region

Name of TRO	Additive model		Fuzzy Logic	
	Attrac-tiveness	rank	Attrac-tiveness	rank
Lekeche	0.094	5	0.079	7
Myhove	0.084	7	0.064	10
Chernivtsi	0.178	1	0.131	2
Vygnytysya	0.124	3	0.110	5
Aqua+	0.073	9	0.071	9
Putyla	0.101	4	0.119	3
Bila Krynysya	0.075	8	0.099	6
Hotyn	0.140	2	0.114	4
Novodnis-trovsk	0.036	10	0.078	8
Repugentsi	0.089	6	0.131	1

The ranking obtained under the calculation are presented in Table 1. As it can be seen from the comparison of quality indicators of tourist attraction designed by different methods, they are similar for all TRO (Vykylyuk & Hats', 2011) (Vykylyuk & Hats', 2009). The correlation coefficient between the rows values is $R = 0.64$. The low level of correlation caused by a non-linear method based on fuzzy logic. Indeed, among the objects of the study appear TRO, which provide significantly different tourist services in different seasons, which clearly shows itself nonlinearity model (Vykylyuk Y. I., 2010A) (Vykylyuk Y. , 2010B).

If one selects vacation or territory of investment projects set of alternatives is important not the absolute value of attractiveness and rank specific TPO among a plurality of objects. Therefore, the method used Spearman's rank correlation for received data calculated ranks. Determination of the Spearman's rank correlation based on a

calculation of the different ranks values of two methods (Vykylyuk & Artemenko, 2010)

The rank of TRO is important instead of the absolute value of attractiveness when you select vacation or territory of investment projects from a set of alternatives. Therefore, the Spearman's rank correlation method was used. Definition of Spearman's rank correlation coefficient based on a calculation of the difference of rank values of two methods (Vykylyuk & Artemenko, 2010):

$$p = 1 - \frac{6 \sum_{i=1}^v d_i^2}{v(v^2 - 1)}, \quad (1)$$

where:

p – Spearman's correlation coefficient,

$d_i = x_i - y_i$, $x_i; y_i$ – value respectively 1st (x)

and 2nd (y) samples;

v – the number of sample values.

6 ANALYSIS TECHNOLOGY OF NATURAL HAZARDS BASED ON BIGDATA

The set of key factors and time delay, which became the basis for the construction of three ANFIS models, has been established because of research. These made it possible to establish the functional relationship between the characteristics of solar activity and the origin of forest fires.

It was determined that this problem relates to the problems of nonlinear programming and any linear transformations can lead to loss of hidden dependencies and are unacceptable in problems of this type (Radovanovich, et al., 2014).

As a result of the sensitivity analysis, it was determined that the resulting models can explain up to 47% of forest fires, which in turn correlates well with the number of unexplained forest fires (39.4% in the US). Deviations in amplitude within 5% confirms the accuracy of the simulation. Unexplained forest fires in these calculations refer to cases associated with human factor, lightning or heat.

Thus, obtained models are adequate and accurate and can be used in the construction of crisis prevention information systems.

7 SYSTEM COMPONENT "MULTIMEDIA GUIDE"

The methods that are used by the component "Multimedia guide" and developed by the authors are intended to provide automated dynamic individual formation of multimedia content to provide user mobile information support as one of the basic functions of intelligent system "Mobile Information Assistant of the Tourists" (Pasichnyk & Savchuk, 2015) with regard to his individual needs, wishes, velocity, and the overall duration of the tour.

Tourist route is provided in the form of a directed graph, which vertices are the target points, edges are transitions between them. They are loaded with values of temporal duration, loops on the graph reflect the possibility of stopping in any tourist place and appropriate time are the hinges duration of the stop.

The end-user of mobile software and the algorithmic application will be able to choose the key points of the future tour route and sequence set of their visit. Using Google Maps tool the tourist selects destination points and the order of their visit and clarifies what kind of trajectory guided tour will take place (Savchuk & Pasichnyk, 2016). Itinerary of the tour the tourist planned is a customized tour and is given by an array of target points: $\bar{x} = [x_1, \dots, x_n]$.

The knowledge base consists of a set of DAISY-guides (tourist-oriented books "that talk") and "Quantum of knowledge" are paragraphs of these guides.

The algorithm of dynamic formation of personalized multimedia content subsystem operation for the user information support during individual trips, implemented into the intelligent information system "MIAT" consists of four stages (Savchuk & Pasichnyk, 2016).

Step 1:

The first step is the input and analysis of input data (tourist enters the name of the start and end points of the tour route or marks them on the map).

Step 2:

When choosing a tour route, using tools Google Maps, it provides the latest information on the

following: start and end points of the route (street name, house number and it coordinates); the names of objects on the route, if any exist (eg. "John the Baptist Church"); total duration of the excursion (this takes into account features of mode of travel - hike, by car, etc.). Thus, the software module of the system "MIAT" receives input for further automated selection of thematic content and computing durations of sound recordings on the relevant points of the tour route.

Step 3:

According to input data obtained in Step 2, the component conducts a comprehensive analysis and searches through the DAISY-book for the relevant sections and phrases that match the subject content on a particular object (point) of the tour route.

Thematic content consists of a list of phrases that are relevant to the section/sightseeing object (building, cathedral, museum, area, etc.). For the process of finding, comparing and selecting of the required phrases or set of phrases corresponds to the software module of the intellectual system. It is based on solid values of "quantum of knowledge" playback duration of DAISY-guide.

Step 4:

In this step, the subsystem fulfills the layout and synchronization of fumed content for excursion guidance of the tourist route.

8 CONCLUSIONS

The architecture of innovative endowed with intelligent features software and algorithmic complex oriented to information technology support and maintenance of tourist at all stages of the trip (before, during and after its implementation) is designed.

A recommendatory security component "Safe Tourism" of intellectual information system "MIAT" is designed to support tourist in making its decisions about their travel.

The method for determining the recreational attractiveness based on Fuzzy Logic is developed. The highest degree of adequacy and accuracy compared with existing classic linear additive methods has been proven for this method. The method allows to determine the optimal location for placement of new tourist

facilities and scientifically grounded chooses the investee. The method of calculating attraction territories allowed compute maps of recreational attractiveness that included seasonally features for the Carpathian region and Euroregion "Upper Prut" that made it possible to determine the best places to invest, to calculate the degree of utilization of resources in the region.

The comparison of ANFIS and neural networks methods in the problem of finding a functional relationship between the occurrence of forest fires in the US and factors that characterize solar activity was analyzed. For do this, several analysis methods (methods of eliminating seasonality, R/S analysis, Data Mining) was used to establish potential links between variations in certain parameters characterizing solar activity and the occurrence of forest fires taking into account the delay in time. The relationship was

found and prognostic scenario based on ANFIS and neural network technology was developed. These methods, in some cases, can achieve forecasting accuracy to 93%

Methodological innovative approaches are developed and innovative subsystem intelligent system "MIAT" (Mobile Information Assistant tourists) is designed to provide formation and processing of audio and video content that is required to support the individual user at the time of his tourist excursions.

The structure of the navigation system components of "MIAT" in the conditions of complexly structured tourist facilities is designed and the algorithm of positioning the mobile device (smartphone, tablet) in a difficult organized space of tourist sites, based on the combined technology of location that is to use Wi-Fi and GPS positioning is developed.

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