

Dynamic characteristics of perspective touristic information technologies

Olga Artemenko¹, Natalya Kunanec², Volodymyr Pasichnyk², Valeriya Savchuk²

¹*PHEE Bukovinian University; e-mail: olga.hapon@gmail.com*

²*Lviv Polytechnic National University; e-mail: valeriia.v.yehorova@lpnu.ua*

Received October 19 2015; accepted November 25 2015

Abstract. The article is devoted to modern tendency and problems in the development of information technologies in the sphere of tourism. The aim of this paper is system analysis and identification of prospective areas of information technology in the field of tourism. The basic trends shaping the prospects for improvement in the information technology tools oriented to full and quality to meet the needs of ordinary tourists are consolidation of information resources in tourism; intellectualization of functions for software and applications, information technology and systems; interface virtualization environment for information systems, oriented to the needs of tourists; mobilization of tourists information technology support in the exercise of his trip; personalization tourist information needs, taking into account its specific individual requests tastes and preferences. All of them are analysed and described in the article. As a result author distinguished the main problems in the sphere of information technologies for tourist domain and main perspective spheres of next researches.

Key words: information technologies, tourism, consolidated information, mobile geographic information system, GIS, mobile tourist information technologies, trip support, interface virtualization environment, intellectual systems.

INTRODUCTION

Tourism is a very relevant business sector and plays a significant role in the global economy, accounting for a large part of world GDP. According to recent data, the annual growth of investment in the tourism industry is about 30% [1].

In recent years, the use of modern information technology (IT) systems have increased the pace of tourism development and most of the components of these systems have become successful e-business projects in their own right. Key participants in such projects are usually major airlines, hotels and tourist corporations on all continents. Information technology increases the efficiency and relevance of tourism services.

About two-thirds of the world's tourists use information technology to plan and support their journeys, with most of them doing so on mobile devices [2]. There is an urgent need to create quality tourist information for mobile technology to assist the user in the planning, maintenance, support and analysis of travel experiences using one integrated mobile software and application.

The development of the tourism industry is interdependent on other related industries - usually transport, communications, trade, construction, agriculture and the promotion of the social and economic development of communities. To increase the awareness of tourists on the range of travel services offered by companies and organisations calls for the promotion of a consolidated information resource.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Researchers and developers are working proactively to create new tools and methods for the filing and processing of tourist information and they are designing intelligent systems to generate personalised recommendations. Powerful professional centres of advanced mobile information technology for the tourism industry include The Digital Tourism Think Tank [3], the International Federation of IT and Travel & Tourism [4] and the University of Bournemouth (England) [5], Lugano (Switzerland) [6].

Baseing on an analysis of the extensive list of information sources, the authors concluded that existing information technologies that are focused on the needs of individual travellers do not provide them the full information support during the implementation of their travelling experiences [7].

It remains not fully worked out problems of consolidated information resources tourist profile, as well as their technological support using conceptual approaches to data warehousing, data spaces and big data. A separate topical issue in the field of information technologies in tourism is the lack of providing the user with personalized advice into account not only the wishes of tourists, but also his personal characteristics and circumstances.

Given the fact that most tourists traveling families or small groups, in the segment of modern IT there are not enough technological tools that would take into account the individual characteristics of travelers.

Theoretical and methodological framework and practical tools of information technology in the tourism business is covered in the papers S. Melnichenko [8]. In his articles Uhryn D. [10,11] the problems of data processing in tourism were analyzed and effectiveness of

their use in mass accumulation and processing of information and to consider improving the efficiency of tourism through the development of methods and algorithms for designing and modeling data objects space tourism industry.

N.B. Shakhovska outlined the concept of corporate data management technologies in the field of tourism [12]. However, the formation of consolidated information resource of tourism in their work is not considered.

Modern and particularly perspective IT in tourism gradually and inexorably developers are given signs of intelligence. This trend is common and comprehensive as the profile of information technology and algorithmic tools, and the functions that are increasingly receiving a greater extent characteristic features of "intelligence."

Another innovative trend of modern tourism IT is interface environment virtualization. Virtualization increasingly common as in the context of the process of formation and effective functioning of virtual travel agencies and business companies and in the context of building a system of virtual reality and reality with elements of GIS applications, including 3D image.

An outstanding is a trend of increasing popularity of mobile information technology focused on the needs of tourists, which in turn is due to the convenience and powerful functionality using mobile computing and communication devices by tourists during the planning and realization of the trip.

The analysis of the vast array of information sources can be argued that none of the currently existing mobile tourist information systems focus not fully meet the complex needs and requirements of all potential users. The authors initiated the development of intellectual information system of the next generation "mobile information assistants tourist" (MIAT) that satisfy a wide range of information needs of tourists in all stages of planning and implementation of his trip and will fill to a certain extent existing technological niches in the sector of information and technology market .

OBJECTIVES

The purpose of this paper is system analysis and identification of prospective areas of information technology in the field of tourism.

To achieve the goal, it was decided the following tasks:

- held alalzyz of information sources on IT development in tourism;
- the necessity of the use of consolidated information in the field of tourism;
- formed the basic concepts of IT intellectualization tourism;
- analyzes the role of virtual companies in the field of tourism was provided;
- is defined prospects of development of fixed and mobile GIS oriented and needs of tourists.

THE MAIN RESULTS OF THE RESEARCH

An analysis of the vast array of scientific publications, reports and monographs were identified system features basic IT promising areas of research in the field of tourism.

The basic trends shaping the prospects for improvement in the information technology tools oriented to full and quality to meet the needs of ordinary tourists are:

- Consolidation of information resources in tourism;
- intellectualization of functions for software and applications, information technology and systems;
- interface virtualization environment for information systems, oriented to the needs of tourists;
- mobilization of tourists information technology support in the exercise of his journey;
- Personalization tourist information needs, taking into account its specific individual requests tastes and preferences.

Consolidated information in tourism.

Based on the interpretation of the term "consolidated information" as received from several sources and system integrated heterogeneous information resources together have signs of completeness, integrity, consistency and make adequate information subject area model for its analysis, processing and efficient use in decision making [9], the formation of such an information resource for the tourism industry is a reliable guarantee its effective functioning and steady progress.

Consolidated information resource occurs in several stages:

- search and data collection;
- pre-processing and structuring of data (data transformation to information);
- Analysis and synthesis of information - its transformation into knowledge;
- consolidation of information resources.
- developing a range of information products to meet the information needs of potential customers.

It should be noted that the procedures for the consolidation of information along with the procedures federalization form a complete set of methodological approaches to the problem of integration of information resources. This consolidation provides a deep and essential zintehrovanist information than the procedures federalization. Please note that the notion of "Consolidated Information" in many cases quite correctly identified with common in business circles concept of "competitive intelligence».

From the standpoint of information industry professionals of competitive intelligence as we treat legal implementation processes of selection, registration, processing and presentation of consolidated information about competitors and the competitive environment, the people who make decisions to improve business processes to reduce risk and improve efficiency of business systems. In our opinion, the accompanying definitions are essential and methodological and verified. Fixing it is this interpretation we:

a) defines competitive intelligence as a separate information activities with consolidated information resources;

b) determine who is a consumer of information resources as consolidated performance of specialists and competitive intelligence services;

c) defines the purpose of conducting competitive intelligence, namely reducing risks and increasing business efficiency and no fix possible types of risks and types of profiles and efficiency.

In this interpretation competitive intelligence is nothing more than a type of media consolidation and its outcome information is consolidated or consolidated information resource formed to ensure the correct management decision-making under risk and competitive environment.

Promoting implementation means consolidation of administrative functions is a mandatory attribute management processes. It is through the information component of a complex system, a type of tourism industry which is capable to interact purposefully with the environment, coordinate relations own components to direct their movement to the desired goal.

Consolidated information is formed using methods, means and methods, based on the information-analytical and system-analytical approach [14].

Development of analytical activities in the area of consolidation of information allows us to consider it as an independent branch information support, providing implementation and use of information technologies in enterprises and organizations.

Methodologically information and analytical activities to develop a consolidated information resources travel company that contributes to its development, is embedded in the following sequence of procedures: Search for available sources of information; analysis of information flows and data sets; the selection of relevant information that meets the needs of the organization; analytical and synthetic processing of information using new technologies; quality control and reliability of existing information resources; forming the system of archiving and preserving information; to provide potential customers with necessary information; organization of information resources management processes; monitoring and support of the security information in a computer system [16].

In today's business processes are gradually emerging understanding that the effective functioning of the tourism business not only material, financial and human resources. Priority should be given information component that ensures the creation of sustainable competitive advantage.

One way of improving the management of the enterprise in tourism is sustainable management of consolidated information resources. Creating a consolidated information in the tourism industry contributes to its economic potential and ensure effective use of sustainability.

Consolidated information resource of the tourism industry contributes to the problem of wider review of potential tourists from tourist attractions. Tourism development as a regional and local dimension is one of the main sources replenish the budgets of different levels [15]. In the context of the Galician region (Ukraine) it provides an affordable and complete rest and recreation of citizens, helps them to learn the history and culture.

Natural resources and historical and cultural potential of Galicia in combination with favorable geographical position is sufficient prerequisite for the effective

development of tourism. For the region, in particular, is characterized tourists historical, cultural and architectural monuments, health and medical tourism. The main historical, cultural and architectural monuments in Lviv region as one of the elements systemoutvoryuyuchy territorial Galicia are: museum-reserve "Olesko", "Zolochiv castle" castle and other buildings, united in the "Golden Horseshoe" of Lviv region, reserve "Tustan" in s. Urich Skole region, literary-memorial museum of Ivan Franko - "Nahuievychi" in Drohobych district and others. The centers are Sacred tourism Univ, Krekhivsky monastery Stradchanska cave church and others.

However, the region's tourism industry has not yet developed the desired pace. One of the major reasons that inhibit these processes is the fragmentation of information on the tourist and recreational services. There is an urgent need to consolidate this information and formation on the basis of a powerful multifunctional content.

Formed for this purpose (for example, Lviv region (Galicia, Ukraine)) consolidated resource consists of oshyrnyh information on tourist facilities, provided in the relevant tables: castles, historic sites, recreational areas and places of pilgrimage and so on. AI. Improvement and development process of consolidation of information is closely related to access to information and market new technology developed that embody the concepts and knowledge databases, data warehouses (data marts and kiosks) [13], space data, large data that represent the current spectrum of integration of information technology.

One of the most powerful methods of information consolidation is kontent- monitoring, which allows forecasting and operational analysis of the market situation.

Content monitoring can be viewed as a classic adaptation of content - analysis of the terms of dynamic information files, including powerful information streams that are increasingly called big data (Big Data). This approach makes it possible to detect non-obvious patterns in data arrays or documentary texts, which are often referred to as latent (hidden) knowledge.

This allows you to create information products using the technology content - monitoring that is searching the "raw" data previously unknown hidden knowledge, providing a significant increase in the efficiency of decision-making.

A typical task in the process of consolidation of information, which is implemented using content - monitoring information is to find exceptions, ie search for information objects and entities that are allocated individual characteristics of the overall dataset.

Separating system features inherent in modern information technologies in tourism should be among the first to define the processes related to active use methodological basis of consolidated information. This trend of improving IT travel direction is dominant and comprehensive as equally successful when used as information support of the formation of objects of tourist infrastructure and the direct conduct of tourism business. Do not bypass this system trend information technologies oriented to the needs of ordinary tourists, including the

whole range of information technology services for its maintenance and support before, during and after exercise of tourist travel.

Advisory tourist guidance systems

One promising profiles improvement of tourism information systems are intellectualization of functions for software and applications. Note that in this context the rapidly emerging and developing original architectural approach to building Expert Systems Division, which is the advisory class (recommendation) systems for the tourism industry, particularly the route planner.

The analysis and comparison of the functionality of the four most popular mobile applications oriented route planning, the authors reviewed the methods and means of forming personal portrait Information / tourist profile, which are mainly implemented mechanisms inherent problem-oriented recommendation systems

Note that in this context the rapidly emerging and developing original architectural approach to building Expert Systems Division, which is the advisory class (recommendation) systems for the tourism industry, particularly the route planner.

Advisory (recommendation) system is an intelligent information system to form recommendations for the sequence and the list of possible user actions in the process of solving them specific problem task. Deliberative systems provide:

- online access to information resources and analytical services advisory system;
- support the formation and build-up of thematic databases and knowledge;
- consolidation and storage;
- full-text search of information;
- experts work on-line.

Powerful development and dissemination of recommendation systems, in addition to tourism, have been in business where used to improve interaction with customers, producing individual proposals that demonstrate best meet their requirements. The specific operation of original algorithms such as systems generally available to the public and trade secrets of companies that use them.

Recommendation systems can be used for filtering and selection of a wide range of necessary user

information. This function extension of systems is becoming increasingly important given the growth rates of new information, leading to a significant complication of procedures for an integrated and systematic use.

When developing current recommendation systems are widely used research results from the fields of data mining and machine learning. The above issues intensively discussed by experts in the framework of the authoritative international scientific conferences, which are RecSys (recsys.acm.org), SIGIR (sigir.org), KDD (kdd.org).

Recommendation systems are becoming more common as advanced software algorithmic implementation of information technology designed to help the user to solve the problem of choosing the best, in his view, option among many alternatives. Use of recommendation systems in collaborative environments is important and allows for filtering of original algorithms that significantly improves the quality and efficiency recommendations.

There are examples of successful technological implementation of the concept of modern recommendation system for planning individual and group tourism itineraries, which, inter alia, in the decision taking procedures used parameters such as age, group size, gender, social structure and cultural level and profile members and others.

Tourism advisory systems have a broad range of approaches and methods of decision making. In particular, the analytic hierarchy process and utility functions, genetic algorithms, fuzzy decision semantic networks are utilized. The common feature tourism advisory system is a three-tier structure used models of decision making (Figure 1).

The first step is to establish the wishes of tourists every available model selection criteria. The characteristic feature of this type of intelligent information systems is the existence of the database, which contains an extensive list of possible recommendations. Recommendations are generally submitted a set of facts - values for selection criteria for a particular case. The next step is set correspondence between user-selected values and actual values for each of the database objects. In the third step is forming a list of recommendations for the best measures resemblance to the user's request.

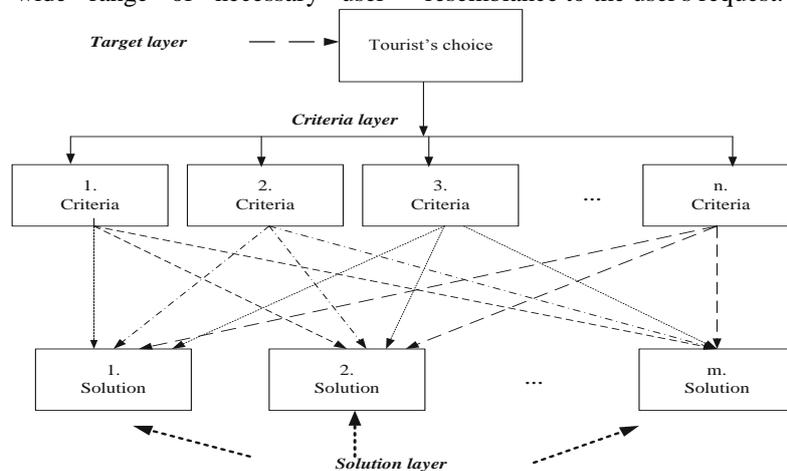


Fig. 1. The hierarchical structure of the travel advisory decision-making systems model.

E-tourism recommendation system as a specific class of intelligent information systems designed to provide offers to tourists at various stages of their journey. We know that the larger the number of available tourist options, make it more difficult choice. Tourist recommendation systems make it possible to provide technological support to guide decision-making in various subject areas.

There are systems that are focused on solving specific problems, such as selection of dining, housing, vehicles, historical monuments or popular tourist destinations. Others offer visitors comprehensive plans routes and trips that include multiple domains simultaneously.

There are several implementation of recommendation systems-oriented selection of proposals for a visit of a restaurant for the user. The study [17] presented data system *Entrée*, which recommended a particular restaurant using knowledge based approach. Knowledge Base system was formed according to the analysis of samples previously carried by the user: shearched analogies and associations of users in previous decisions on the criteria of "price" and "kind of cuisine."

Eventually *Entrée* was improved using the method of Collaborative filtering in the analysis of the knowledge base. This means that in addition to the customer's wishes and features a restaurant, estimates that users left after visiting recommended establishment also has a set of criteria for selection of potential options.

Another example of the tourism system is a mobile recommendation application designed to generate proposals for tourists visiting restaurants in Taipei (China) [18]. This information and technological development is a mobile recommendatory system that allows users to relevant proposals in real time, using Content-based recommender system.

CATIS [19] is recommendatory multitask system which generates a custom context-sensitive proposals for tourist accommodation, restaurants and attractions that may interest them. A feature of this system is the existence of a special dynamic manager who selects context information from the user's mobile device (eg, position and trajectory of the movement, history of requests, etc.). Recommendations are generated by combining the user's query parameters and analyzing contextual information about it.

Another analogue of recommendation information technology application for choice of dining is REJA (REstaurants of JAén), to implement a common approach which combines filtration and analysis of knowledge [20]. Recommendations can be provided using the common method of filtering when the system was able to build a profile in accordance with his requests and history using the application. When the system is not user information relevant recommendations generated using a knowledge base.

Personal tour planning system PSiS, created to help tourists in creating their individual plans excursions in Porto (Portugal) [21]. To avoid the shortcomings of many existing recommendation systems, including such which is the issue of the first evaluation, lack of data to create accurate user profile developers PSiS was proposed

hybrid approach when forming the set of recommendations.

The proposed hybrid approach uses the methods of building recommendations based on collaborative filtering, content analysis algorithms in conjunction with clustering and build associative rules, as well as the application uses fuzzy logic to enhance the quality of recommendations.

Similarly constructed advisory information technology application SigTur [22] provides personalized recommendations for tourists in the region of Tarragona (Spain). To ensure high quality recommendations SigTur uses several types of information retrieval and recommendation methods. The information used in the application includes demographic data, contextual information journey location data.

SigTur combines a number of methods of generating recommendations, including using stereotypes (standard tourist segments), methods and means of artificial intelligence, including clustering algorithms, an ontology and knowledge base to identify new features of similarity between the users based on complex aggregation operators.

Mobile Recommendation System SMARTMUSEUM provides users with recommendations for attractions and some objects might tourist [23]. In the system used ontology approach to provide personalization, filtering and annotation information. Contextual data that has been entered by the user or obtained from sensors embedded mobile devices are displayed in terms specified in the relevant ontology.

iTravel - Mobile application used as recommendatory system was designed to provide recommendations for further tourist travel movement [24]. With the help of tourists who have common interests can share information and experiences about the places visited them in real time.

Moleskiing [26] - an information program-algorithmic product is designed to assist users active planning their winter holidays. He served as a recommendation system for users to exchange views and experiences on the terms and conditions of slopes and descents at specific resorts. This ranking system is supported by the credibility of comments and assessments received from specific users. Tourists wishing to go to the mountainous terrain, could use information about the weather conditions, as well as an assessment of how safe is one or another ski trail regarding their level of ski training.

DIETORECS [25] - a recommendation system that allows you to create a full itinerary of tourist travel. Depending on the wishes of tourists, you can get a list of attractions that may be of interest to the user, or variations of routes and tours covering such objects. Recommendation system for drivers MASTROCARONTE [27] using approaches based on the knowledge base for the development of recommendations on attractions, restaurants, and hotels. The application uses contextual information about the movement of the vehicle to form a convenient travel root for drivers.

The system SPETA [28] uses knowledge of the actual place of residence, history of its past locations and the range of his interests in order to further elaboration of recommendations route. It combines the functionality of social networks, semantic search the Web-space and contextual analysis to support the tourist information in the exercise of his trip.

Proposed in the study [29] algorithmic application allows the user to schedule so-called weekend tours and prolonged (over several days) tour.

Mobile tourism recommendation systems depend on the complexity of the tasks and requirements for submitting a speed of different methods of generating recommendations. To provide recommendations for relatively simple tasks such as the choice of a restaurant or hotel, are commonly used methods common filtering and / or analysis of user relevant content.

For developing of more complex recommendations, including proposals for the implementation of tourist routes and trips, the knowledge base and hybrid methods is used. Implementation of the recommendations in real time, for example for such tasks as finding the nearest petrol station, involves the use of methods and means of contextual analysis geopositioning.

Virtual company in tourism, socio communications aspect.

Active deployment of modern electronic platforms in many business areas resulted in the need to create virtual organizations. Tourism industry is no exception. Create virtual companies travel profile against the background of the formation of large-scale distributed computing, communications, information infrastructure, which in turn is based on interdisciplinary approaches.

In this context, more obviously and naturally raises the problem of developing a new class of social communicational methods and tools, and related technologies that are based on them and are oriented to use in the efficient functioning of virtual organizations.

The authors analyzed the main social communicational problems and proposed original approaches to the formation of virtual agencies in tourism industry.

In the works of D. Zonnenwald an analysis of the concepts of organizational structures in the form of virtual organizations [30] and information exchange technologies features are presented [31]. In a number of publications [32-34] different ways of establishing communication in virtual settings are analyzed. Problems of development of virtual organizations are discussed in the article «Supporting Scientific Collaboration: Methods, Tools and Concepts» [35].

At the initial stage of the forming of methodological concept of virtual entities it is necessary to conduct a comprehensive research that would promote the development of social communicational technologies for individual, group communication of their employees, ensuring sharing of information resources, and effective and easy to use by different specialists of computer telecommunicational and algorithmic infrastructure.

The Formation of socio communicational technologies provides the development of distributed technologies for informational support of teamwork, working out the set of disparated diversified multiformat

conceptual and analytical data, and overcoming language barriers and geodisperse of informational and communicational environment.

The implementation of the concept of a virtual company requires the formation and support of virtual team. Such groups usually bring together geographically or institutionally distributed workers that are specialists in different fields.

The concept of formation and effective functioning of virtual team is reinforced by appropriate architectural and technical solutions that contribute to the desired result. This generates a need for choice of partners, taking into account many factors, both subjective and objective nature [34] and necessarily based on competence approach, which is widespread in human resource management [36]. Competence is the ability of a combination of knowledge and skills to effectively perform clearly defined tasks.

When ranking the candidate to participate in the work of the group external factors that affect the determination of its compliance and can not be classified in a certain way, but only modeled for a particular situation are taken into account. An important role in determining the rating of the candidate plays his teamwork as an important requirement is his / her active cooperation with the team to achieve common business goals.

It is necessary to include specialist of IT industry in virtual teams for technological support of forming consolidated information resources, software development and technical support of computer and telecommunication tools that fully meet the needs of the company. This greatly facilitates the process of developing effective information technology systems and software, which together contributes to the maintenance of the virtual company if it is supposed to use huge databases.

The efficient operation of the company is ensured by rigorous analysis of information technology, suitable to meet the objectives of the company and information technology environment.

The development of virtual infrastructure for the operation of the company in the tourism industry usually occurs with the use of cloud computing technologies, which provide storage and access large volumes of data and knowledge.

An important issue in virtual-organized companies in general and tourism in particular, is to develop user-friendly interface and providr adaptive media communication staff, implemented on the basis of ontological representations relevant problem areas and situations.

Innovative technological challenges of a society based on knowledge, increasingly request form start a new trend of engineering, which the authors propose to call social communicational engineering. The process of designing and building virtual companies in the tourism industry undoubtedly belong to the scientific issues which would have to take care of it social communicational engineering. In order to form a holistic systemic interpretation of this concept and its terminology submissions propose the following definition of the

concept of "social communication". The necessity of such sequence is pointing definition of relevant concepts naturally stems from their structural and functional subordination of ontology in general subject area "Social communication". The term social communication we understand complex technologies, implementing the system of social interaction that provides communication processes of social institutions, organized communities and individuals.

The above definition of the term is original and somewhat different from the lengthy, often verified interpretations of the term "social communications" that are fixed in some terminological dictionaries.

Based on this formulation of the term the concept of "social engineering" can be defined as follows:

Social engineering is the science that studies and investigates the methods, means and ways of designing and constructing of elements, subsystems and systems of social communications in the Information Society, and later in the knowledge society.

With this understanding of a new kind of engineering we will submit a list of objects that are the subject of study and research of social engineering, in particular they are: social network; of e-governance; of e-science; of e-business; e-learning system; real and virtual social communicational communities; social institutions such as libraries, media archives and others.

Therefore, when creating a virtual company in the field of tourism it is advisable to use a wide range of social communicational methods and tools that ensure effective implementation of its functions with the use of modern computer and telecommunication technologies. Moreover, integration of information resources in these systems provides the use of the principles of consolidation and federalisation.

One successful example of this class of building is an international project that successfully operates in the structure of the Swiss Virtual Tour operator SwissHalley [37].

Geoinformation technologies oriented on the tourist.

In the tourism industry there are quite a lot of research and applied problems in the solution of which it is necessary to decide on the relative position of objects in space, routing, determining their length and complexity, optimal route selection etc. [38, 39]. Modern analysis of spatial distribution facilities is based on the use of geographic information technology (GIT). One of the promising areas of research is the application of GIT to tourist support tasks at all stages of his journey.

The main tasks that can be solved with the help of travel GIT are: creation of electronic versions of popular tourist destinations; locationing tourists, tourist facilities, vehicles, etc.; construction of a tourist route; maintenance of tourist travel; trip planning; virtual tourism, 3-D versions of tourist sites; thematic digital maps; dissemination of information on tourist facilities; analysis of tourist flows and spatial distribution of tourism resources; searching for diverse information in the field of tourism.

Different categories of tourists can use a variety of GIT at all stages of the trip:

- In preparation for the trip using GIT tourist can search data on facilities, trails, infrastructure; planning a trip and travel routes.

- When travelling with a mobile tourist application based on GIT it is available to use options such as location tracking, tourist facilities search, maintenance and adjustment of tourist route [39].

- After completion tourist travel GIT allows you to perform data analysis on tourist flows, the formation of reviews and evaluations, the exchange of experience (in many mobile applications are tools for creating voting and rating the quality of services, etc.) [38].

The leaders in the development of global GIS are now the products of two companies: these are system ArcGIS American firm ESRI and MapInfo – Corporation INTERGRAPH. Also, for the implementation of tourism GIT- applications GoogleMaps is often used [38]. To implement some specific tasks, such as virtual tourism created specialized GIS platforms, such as Cyber GIS [40].

Information technology decision support tools targeted to the specific needs of tourists and travel agents are developed and improved in the direction of mobile and web-based applications. The tools to solve the problem of personalization, optimization and maintenance of tourist during his stay on the route are among them.

The study [29] proposed an interesting algorithmic problem solving search for information on tourist resources and route planning. By user request are available spatial data on the location of social and tourist infrastructure, photographs and text information about places of interest and entertainment, as well as transport routes that take you to these places for a given initial position. The solution implemented in the form of application on Windows platform Visual Studio, export of geospatial data is GIS MapInfo. Information on tourist resources processed in the system in two modules: GIS geospatial data in the form of digital maps and additional information on resources in the form of metadata, access to which is realized through ADO components. The disadvantages of the proposed approach can be considered static presentation of data in the system and the lack of online access. Accordingly, the user has no possibility to carry out inquiries in real time and pave the way for the desired object from the current position.

Most mobile applications, travel guides and programs require the provision of tourist in space. The open question remains to determine the exact location of the tourist inside buildings, palaces, museums, historical or cultural complexes. To program guide automatically started and began the story of a particular memo or picture, you need to know not only exactly where it is a tourist, but also in which direction he is looking and where you want to move on. Find the external location of the user can be realized using GPS. Once is a famous tourist positioning of GPS, you can practically define the objects that the user is watching at any given time. However, there is no effective information technology for solving the problem of determining the coordinates of domestic tourist location as well as individual objects, such as inside a large museum. This would give an opportunity to develop a software solution in combination

with a program-guided, GPS-transmitter and GIS system, which offered to tourists - the owners of mobile personalized tour in real time [41].

The original solution to the problem and correcting laying route travel is a mobile application based on GIS and multi-agent system [42]. In application can be used geospatial information with commercial GIS formats such as ArcGIS and Mapinfo. Performing the transformation of geospatial data in GML, which makes it possible to ensure the flow of geospatial data to users of portable devices is freely without commercial plug-in software. The focus of the study, the authors focus on creating and implementing multi-agent system of choosing the best route. The algorithm is based on a multi-agent system at user-specified radius, specify factors to calculate the optimal path from one node to the target node map, given not only the length of the route, but traffic flow, the cost of commercial roads and other factors.

In the study [43] is shown the developed thematic digital maps containing information about hotels, guest houses, tourist routes, airports, railway stations, parks, churches, playgrounds, golf courses, hospitals, centres of ATM, restaurants, gas stations, police stations, water meters and entertainment facilities. Srinagar (India) for further integration with the web space to promote a tourist environment of information and assistance to potential tourists in the decision on travel itinerary respective regions, based on ArcGIS and Software ESRI 10.1. Digital maps, satellite images, GPS and statistics were used to create data layers above and were then combined with additional materials such as multimedia video clips, audio stories and photos. It is possible to develop web-based travel advisory information system that enables you to generate a number of answers to user queries on his / her trip to the city Srinagar:

- Where are the tour routs?
- What is the shortest way to reach a specific destination?
- What is the weather and geophysical situation of the destination?
- What is the best time of year to visit the city?
- What types and classes of accommodation are available, their cost, location, living conditions?
- Where are the important shopping centers, ATMs, parks, etc. Etc.?

The information system provides the user a number of tools to display the source data as a 3D maps, SQL-tables and queries.

The research [44] is devoted to the problem of getting personalized recommendations for tourists on daily excursion routes. The authors approach is that for preformed user list attractions that travelers like to visit, get the route for each day of the visit. The long journey is shares on separate days and formed a list of attractive tourist destinations which are grouped thematically or geographically distributed between these days. Places of possible interests are selected according to conventionally implied user preferences. The method allows the following: the individual planning of personalized daily tours based on user preferences, the time allotted for the tour, availability to visit monuments (schedule), the number of days of stay. This software application is available for web and mobile users.

Governments in countries with developed tourism markets ate interested in services creating to provide personalized information to tourists. For example, in Thailand a study intended to facilitate tourist in points of interest search and trip planning is performed. The application is designed in such a way that when filling relevant database it may be applied in other regions. The structure of the software modules is formed as an open architecture that allows other developers easily integrate it into the environment for relationship-oriented provision of other information technology services for tourists [45]. This development consists of three components: machine recommendation (PPR), route planner (IP) and mobile application (MTG). Together they form the basis for personalized travel planning system for Thailand. PPR service provides a set of recommended for tourist sites and attractions (Points of interest - POI), corresponding to the user's interests. IP Service publishes a number of routes based on user requirements. Service MTG is actually a mobile interface that provides access to information on tourist services associated with the user's interests, its current location, travel time and others.

Planing the trip is formally regarded as a complex and time-consuming tasks that includes a variety of processes, ranging from finding specific tourism information on the country and accomodations of stay in it and completing the on spot planning of trip routes in unfamiliar areas. Information Technology Service provides the collection of data from various sources, including static and social, and further recomends the user points of interests (POI) and routes to pass the maximum number of POI, with maximum regard to his personal requirements and interests.

Trends that are traces in the markets of tourist information technologies, identify personalization and information-technological support of tourist at all stages of his / her journey, information and cognitive tourism thematization and adaptation to individual wishes of tourist and his/her financial opportunities.

From the above examples of modern developments in the field of tourism GIS applications, we can conclude that each of them is focused on solving of one or two problems that must be addressed to tourist during the trip. In addition, none of these applications does not provide IT support to the user at all stages of his journey. Another disadvantage of many developments is their "narrow" focus on separate resort area, city or tourist attraction [43,44].

Mobile information technologies for individual tourists.

Every tourist meets a large number of problems at all stages of the trip (before, during and after its implementation). He / she should always give answers to the question "Where?" "When?", "How?", "What?", Etc. [46]. The main aim of modern mobile information technologies in the sphere of tourism is to support the tourist during his trip any where and any time.

A group of researchers from the Lviv Polytechnic National University developed an innovative technological project of intelligent system "Mobile

Information Assistant of Tourist" (MIAT) in which a prototype of mobile integrated software and algorithmic complex of next-generation was worked out. Its basic functional purpose is to provide comprehensive information technology support to tourist at all stages of their travel. [47]

The project "Mobile Information Assistant of Tourist" is the development of innovative software and algorithmic complex based mobile computing and telecommunications.

In accordance with the objectives of the project following requirements for functional content of intellectual information system are formed: providing personalized information at any time, forming personalized routes with the possibility of changing it during the trip, assistance in choosing and reservation of transport and place of residence, location and navigation user during travel, travel budget calculation, generation trip costs report and a travel diary, the presence of off-line mode, providing tourist guide services (predictive maintenance) and augmented reality mode when user visits a particular tourist attraction [47].

The main feature of the system is to provide complete, accurate neprotyrechlyvoyi, consolidated information to the user in accordance with the basic information and technological slogan "EVERYTHING!

HERE! IMMEDIATELY!!! ". Said intelligent information system should provide the necessary comprehensive tourist information support at any time and any where[47].

Functionality of the system is shown in Figure 2.

MIAT - is a complex structured software and algorithmic complex, requiring powerful hardware and software. Thus the main hardware of the client of the system is a mobile device with GPS antenna and the ability to connect to the Internet.

The main components of the intellectual information system are:

- Polls and preliminary analysis of results – this component is responsible for the users interviewing, formation of his/her account, recording gained data to the database of tourists and a general analysis of user responses with an aim to define general personality features of the tourist.
- Generation of recommendations for choosing a tourist destination – a component of decision support when choosing a certain tourist destination. The result of its operation is a personalized list of tourist destinations offered to a specific user. Recommendations are generated based on the survey and supported by information obtained from the Google Maps service.

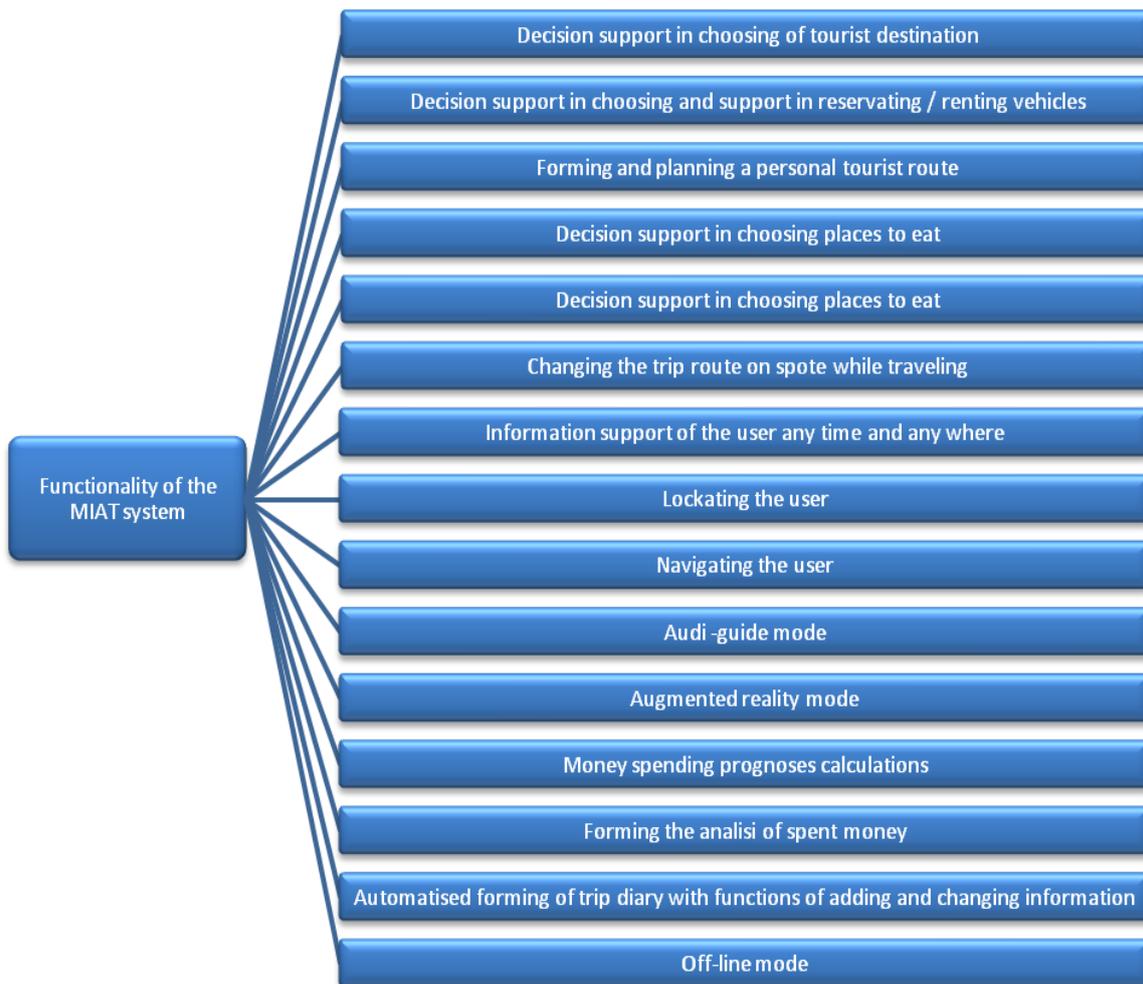


Fig. 2. The functionality of MIAT system.

- Route planning – this component has a complex structure and is responsible for a personalized selection of tourist facilities that are offered to the user to visit, their agreement with the tourists and planning optimal trip routes according to the wishes of the user, available budget and duration of the trip. An additional feature is the change of the tourist route during trip implementation, depending on the wishes of the current user and information about its location and providing personalized information about the places food.

- Reservations of accommodation and transport – this component is responsible for assistance in selecting accommodation for the user during his / her trip and transport decision-making. The reservation of selected places of residence and, where appropriate, transport are assumed.

- Selection of database data – a component that ensures the generation of necessary information on the direct request of the user, or to support the functioning of other dependent components.

- Navigation mode and "audio guide" – a component that provides a definition of the place of residence, users navigation on the tourist route and provide the user with information about tourist sites that are nearby. When the mode "audio guide" of the component is turned on, in addition to voice driving directions, the component provides detailed qualitative information about tourist points of interest that are in close proximity to the user in audio format. Without GPS, or connection to the Internet on a mobile device, the user will have the opportunity to inform the system about his / her current location.

- Augmented reality mode – a component that implements the operation of the augmented reality mode during a trip. What does it mean is: if there is a photo/video cameras in mobile devices, the component impose a label with information about further recommended direction of travel (using the data components of the "Navigation mode and" audio guide"), and with information about tourist sites that fall into the field of view of the camera of the users mobile device on the resulting image that is got with its camera in real-time.

- "Virtual tourism" mode – a component that is responsible for data acquisition of spherical images of tourist destinations, sending them to the components of the "Augmented reality mode" to be used instead of camera images received from mobile device. As a result, the user will be able to read the travel route planned on his / her mobile device.

- Calculating the budget – a system component that is responsible for the preliminary calculation of the indicative budget of the planned trip and forming the report of spent costs during its implementation. It uses data on the cost of accommodation, transport, food (offering the user to provide a report on the funds spent in catering establishments), entertainment and more.

- Formation of that travel diary – a component that is responsible for the preservation, sorting and description data during users trip, namely: passed route maps, photo and video files indicating heolokatsiy. An additional feature of the component is imaging the stored data sorted in ascending order of date of creation and divided by day to provide user-friendly viewing.

Google Maps is the chosen information system. The authors of this project selected this because of its powerful functionality and information content. Google Maps has a free map service supported by the company's technology. The service contains cartographic data and satellite images of the earth's surface and provides access to the integrated directory of "points of interest and maps of roads plus the Search function for routes [48].

According to research to implement MIAT the following resources will be needed: a mobile device with access to the Internet, a powerful GPS antenna and a server with a storage capacity of more than 1TB.

THE ANALYSIS OF RESULTS OF THE RESEARCH

The rapid development of the tourism industry generates the need to include a growing number of researchers and developers to solve problems and develop effective modern information technology. After processing more than 1500 scientific publications on IT issues of tourism that were published over the last five years, a conclusion can be made about promising profiles in the tourist area of modern information technology and algorithmic tools that provide support and assistance to tourists during all stages of their journeys, as well as the accompanying proceedings of the tourism business and its development.

These profiles and characteristics of current and prospective IT in tourism are:

- consolidation of information resources;
- intellectualisation of functions;
- interface virtualisation of the environment;
- mobilisation of information technology support
- Personalisation of information needs

Consolidation of information in the field of tourism hasn't yet gained full coverage in professional publications of the scientific achievements, although in many writings the conclusion that the consolidated powerful resource provides a significant and effective IT support industry development is traced.

It should be noted that the market for information technologies lacks tour GIS, which could equally be effective in information support and in accompanying tourists during the trip in different regions of the world. Based on the analysis the authors singled out a number of tasks which can and must be effectively and comprehensively implemented with the help of the instrumental algorithmic means of GIS. These include in particular: the choice of the tourist route; maintenance and tourist navigation on the route; adjustment of the route to the current location of the user and their chosen mode of transport; the optimal choice of transport (route number for public transport).

It is worth noting the topicality of establishing a system of integrated information support for tourists at all stages of their journeys and that they should include:

- detailed information on tourist and other facilities
- thematic information about the type and characteristics of various infrastructure facilities (dining, accommodation, entertainment, service departments, etc)

- generation of a list of infrastructure facilities according to the tastes of the user
- augmented reality in the form of 3D-models of streets, buildings and other facilities
- the presence of additional information such as text, photo, video and audio materials in addition to digital maps.

CONCLUSIONS

The result of this research is the justification of basic features of the system and the design of an innovative intelligent information system: Mobile Assistant Tourist Information, oriented to support and assist the user in planning and implementation of tourist trips in accordance with the informational technological slogan: EVERYTHING! HERE! IMMEDIATELY!!! with mandatory compliance on convenience, comfort and privacy requirements while providing appropriate services and relevant information.

In turn, each of the examined system features of modern tourist IT is worthy of separate deep scientific analysis and professional research and the authors plan to conduct such analysis in the nearest future.

REFERENCES

1. Why tourism? World Tourism Organisation UN-WTO. Available online at: <<http://www2.unwto.org/content/why-tourism>> (in English)
2. How do you plan a touristic trip? Available online at: <https://vk.com/feed?section=notifications&w=wall-36752538_55760> (in Ukrainian)
3. Who we are? Digital tourism Think Tank. Available online at: <<http://thinkdigital.travel/who-are-we/>> (in English)
4. Outline and mission. IFITT. Available online at: <<http://www.ifitt.org/meet-ifitt/>> (in English)
5. About us. eTourismLab. Bournemouth University. Available online at: <<http://blogs.bournemouth.ac.uk/etourismlab/about-us/>> (in English)
6. Welcome to the webtelier.net Lab. Webtelier.net. Available online at: <<http://www.webtelier.net>> (in English)
7. **Artemenko O.I., Pasichnyk V.V., Savchuk (Yehorova) V.V. 2015.** Information technologies in the sphere of tourism. the analysis of the use and research results. Journal of Lviv Polytechnic National University. Information systems and networks department. Vol. 814, PP. 3-23. (in Ukrainian)
8. **Melnichenko S.V. 2008.** Information technologies in tourism: theory, methodology, practice: monographic. Kyiv: Kyiv National University Of Trade And Economics. P. 493.
9. The program of tourism and resorts development in Lviv region for years 2014-2017 Available online at: <<http://stsrda.gov.ua/index.php/ekonomika/novyny-ekonomiky/9075-prohrama-rozvytku-turyzmu-ta-kurortiv-u-lvivskii-oblasti-na-2014-2017-roky.html>> (in Ukrainian)
10. **Ugrin D. 2008.** The analysis of systems of tourism data storing and processing. Journal of Lviv Polytechnic National University. Computer Science and information technologies Vol. 616. Lviv: Lviv Polytechnic National University. PP. 175-182.
11. **Ugrin D. I. 2010.** Methods and tools for data integration in the sphere of tourism: dissertation abstract for PhD: spec. 01.05.03 «Mathmanic and program software of computer systems and networks». Lviv, 2010. P. 14. (in Ukrainian)
12. **Shakhovska N.B., Vykyuk Ya.I., Ugrin D.I., Kis Ya. P. 2009.** Strategic conception of corporative data management technologies if as managing unstructured corporative information. Journal of Lviv Polytechnic National University. Information systems and networks department. № 653. C. 207-214. (in Ukrainian)
13. **Shakhovska N., Bolubash U., Veres O., 2015.** Big Data Model "Entity and Features", ECON-TECHMOD. An international quarterly journal Vol. 04, No. 2. - 51-59. (in English)
14. **Kunanec N.E. 2009.** Consolodated information: modern profession of scientific-educational branch of information sciences. Journal of Lviv Polytechnic National University. Information systems and networks department. № 653. P. 157-169 (in Ukrainian)
15. **Melnyk O.V. 2003.** Influence of tourism on the development of region economy Journal of Lviv Polytechnic National University. Economy and management problems. № 484. PP.129-133. (in Ukrainian)
16. **Kunanec N.E., Pasichnyk V.V. 2010.** Introduction to speciality: "Consolidated information": educational manual. Lviv: Lviv Polytechnic National University. – 196 c. (in. Ukrainian)
17. **Burke R.D., Hammond K.J., Young B.C.. 1996.** Knowledge-based navigation of complex information spaces, Proceedings of the Thirteenth National Conference on Artificial intelligence. Vol. 1, AAAI Press, Portland, Oregon, pp. 462-468. (in English)
18. **Hung-Wen T., Von-Wun S.. 2004.** A personalized restaurant recommender agent for mobile e-service, 2004 IEEE International Conference on e-Technology, e-Commerce and e-Service. EEE '04, pp. 259-262. (in English)
19. **Pashtan A., Blattler R., Andi A.H., Scheuermann P.. 2003.** CATIS: a context-aware tourist information system, The 4th International Workshop of Mobile Computing, Rostock. (in English)
20. **Martinez L., Rodriguez R.M., Espinilla M.. 2009.** Reja: a georeferenced hybrid recommender system for restaurants, IEEE/WIC/ACM 2009 International Joint Conferences on Web Intelligence and Intelligent Agent Technologies. WI-IAT '09, IET, pp. 187-190. (in English)
21. **Lucas J.P., Luz N., Moreno M.N., Anacleto R., Figueiredo A., Martins C.. 2013.** A hybrid recommendation approach for a tourism system, Expert Systems with Applications 40. pp. 3532-3550. (in English)
22. **Moreno A., Valls A., Isern D., Marin L., Borràs J.. 2013.** SigTur/E-destination: ontologybased personalized recommendation of tourism and leisure activities, Engineering Applications of Artificial Intelligence 26. pp. 633-651. (in English)

23. **Ruotsalo T., Haav K., Stoyanov A., Roche S., Fani E., Deliai R., Mäkelä E., Kauppinen T., Hyvönen. E. 2013.** SMARTMUSEUM: a mobile recommender system for the web of data, *Web Semantics: Science, Services and Agents on the World Wide Web* 20. pp. 50–67. (in English)
24. **Yang W.-S., Hwang S.-Y.. 2013.** iTravel: a recommender system in mobile peer-to-peer environment, *Journal of Systems and Software* 86. pp. 12–20.
25. **Fesenmaier D.R., Ricci F., Schaumlechner E., K.Wöber, C. Zanella, 2003.** DIETORECS: travel advisory for multiple decision styles, *Information and Communication Technologies in Tourism 2003*. pp. 232–241.
26. **P. Avesani, P.Massa, R. Tiella, 2005.** Moleskiing.it: a trust-aware recommender system for ski mountaineering, *International Journal for Infonomics*. Vol.20.
27. **L. Console, I. Torre, I. Lombardi, S. Gioria, V. Surano, 2003.** Personalized and adaptive services on board a car: an application for tourist information, *Journal of Intelligent Information System* Vol. 21. pp.249–284.
28. **García-Crespo, J. Chamizo, I. Rivera, M.Mencke, R. Colomo-Palacios, J.M. Gómez-Berbís, 2009.** SPETA: social pervasive e-tourism advisor, *Telematics and Informatics* Vol. 26. pp. 306–315.
29. **S. Schiaffino, A. Amandi, 2009.** Building an expert travel agent as a software agent, *Expert Systems with Applications* Vol. 36. pp. 1291–1299.
30. **Sonnenwald D. H., Whitton M.C., Maglaughlin K. L. 2003.** Evaluating a scientific collaboratory: Results of a controlled experiment. *ACM Transactions on Computer-Human Interaction (TOCHI)*. Vol. 10, no. 2. Pp. 150–176. **Sonnenwald D. H., Whitton M.C., Maglaughlin K. L. 2004.** Designing to support situation awareness across distances: an example from a scientific collaboratory. *Information Processing & Management*. – Vol. 40, no. 6.5. P. 989–1011.
32. **Darch P. et. al.** Shared Understandings in e-Science Projects. Technical Report, Oxford e-Research Centre, Oxford University. Available online at: <https://www.oerc.ox.ac.uk/sites/default/files/uploads/ProjectFiles/FLESSR/HiPerDNO/embedding/Share_d_Understanding%2030%20June.pdf>
33. **Andrew Warr, et al.** Project Management in e-Science. A report from the ‘Embedding e-Science Applications: Designing and Managing for Usability’ project (EPSRC Grant No: EP/D049733/1). Available online at: <<https://www.oerc.ox.ac.uk/sites/default/files/uploads/ProjectFiles/FLESSR/HiPerDNO/embedding/Project%20Management%20Report.pdfm>>
34. **Roberts B., Adomas S., Brian M., 2005.** Request based virtual organisations (RBVO): an implementation scenario. Collaborative Networks and Their Breeding Environments: IFIP TC5 WG 5.5 Sixth IFIP Working Conference on VIRTUAL ENTERPRISES (26-28 September, 2005, Valencia, Spain). Edited by Luis M. Camarinha-Matos, Hamideh Afsarmanesh and Angel Ortiz. Valencia. P. 3-17.
35. **Jirotko M., Lee C.P., Olson G.M. 2013.** Supporting Scientific Collaboration: Methods, Tools and Concepts. *Computer Supported Cooperative Work*. Vol. 22. P. 667–715.
36. **Camarinha-Matos L. M., Silveri I., Afsarmanesh H., Oliveira A. I. 2005.** Towards a framework for creation of dynamic virtual organizations. Collaborative Networks and Their Breeding Environments: IFIP TC5 WG 5.5 Sixth IFIP Working Conference on VIRTUAL ENTERPRISES (26-28 September, 2005, Valencia, Spain). Edited by Luis M. Camarinha-Matos, Hamideh Afsarmanesh and Angel Ortiz. Valencia. P. 69-81.
37. **SwissHalley.** Available online at: <<https://www.fireflies.com/>>
38. **Yue Cui, Edward Mahoney 2015.** Employing Internet GIS Surveys to Characterize Recreational Boating Travel Patterns // *Transactions in GIS*, 2015, 19(1): 42–62
39. **Huanhe Y. 2014.** Based on geographic information system of tourism resources and circuit management system design and implementation. *Applied Mechanics and Materials* Vols. 599-601. pp. 2092-2095
40. **HU Qiang. 2013.** Research on The Preliminary Design of 3D Virtual Tour Based on The VRML Technology. *Journal of Convergence Information Technology(JCIT)* Vol. 8. Nu. 6.
41. **Kyubark Shim, Jaegel Yim, Junri Jeon. 2015.** Development of an Indoor-Outdoor Positioning Android App for Anapji Tourist Guides. *International Journal of Software Engineering and Its Applications* Vol. 9, No. 3. pp. 195-208
42. **Min Peng, Naixue Xiong, Jong Hyuk Park, Athanasios V. Vasilakos and Jiawen Zhang. 2012.** The weighted shortest path search based on multi-agents in mobile GIS management services. *WIRELESS COMMUNICATIONS AND MOBILE COMPUTING*. Vol. 12. pp. 302–317
43. **Shamim Ahmad Shah and Muzafar Ahmad Wani. 2015.** Application of Geospatial Technology for the Promotion of Tourist Industry in Srinagar City. *International Journal of u- and e- Service, Science and Technology* Vol.8, No.1. pp.37-50.
44. **D. Gavalas, M. Kenteris, C. Konstantopoulos, G. Pantziou. 2012.** Web application for recommending personalised mobile tourist routes // *The Institution of Engineering and Technology* Vol. 6, Iss. 4, pp. 313–322
45. **Asavasuthirakul D., Harfield A., Kesorn K. 2014.** A Framework of Personalized Travelling Information Services for Thailand // *Advanced Materials Research* Vols. 931-932. pp 1382-1386.
46. **Chalmers M.** Tourism and mobile technology. Matthew Chalmers Available online at: <<http://www.dcs.gla.ac.uk/~matthew/papers/ECSCW2003.pdf>>
47. **Pasichnyk V.V., Yehorova (Savchuk) V.V. 2015.** Intellectual information touristic system based on mobile technologies. *Journal of Mathematic, Information technologies, Education*. Eastern European National University named by Lesya Ukrainka, Lutsk. No.2. PP. 151-157.
48. **Google Maps overview, Google Maps Help.** Available online at: <https://support.google.com/maps/answer/144349?hl=en&ref_topic=3092425>