

Intellectual innovative system for personalized support of tourist trips

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Abstract. The main goal of the article is generalization of intellectual innovation project of information system "Mobile information assistant of the tourist" (MIAT), which provide a full-featured integrated information and technological support to tourists during planning and implementation stages of his journey using a wide range of modern information technologies. About two-thirds of today's tourists use information technology to plan and support their journey, while a significant number of them use mobile computer and telecommunications devices. The result of the research made by the group of researchers of the University "Lviv Polytechnic" is the project of innovative intelligent system "Mobile information assistant of a tourist" oriented on IT support of the user in planning and realization of his/her tourist trip in accordance with information technology slogan "EVERYTHING! HERE! IMMEDIATELY!!!".

Key words: tourist mobile application, tourism, location-based services, location-based recommendations, travel guide, route planning, navigation, indoor navigation, global positioning system, mobile technology.

INTRODUCTION

Tourist industry is rapidly developing and gaining popularity sphere. Despite the unstable situation in Ukraine in the first half of 2015 more than 2.9 millions of tourists had crossed its border [1]. The analysis also shows a significant growth of intrastate tourism.

Every tourist meets a significant number of problems and obstacles that arise in almost all stages of the tour (pre-, during and post realization stages). Tourists are usually looking for answers to the question "Where?", "When?", "How?", "Where?", "What?", etc.

[2]. Good quality tourist trip implementation needs powerful information support.

About two-thirds of today's tourists use information technology to plan and support their journey, while a significant number of them use mobile computer and telecommunications devices [3]. This in turn generates the need to create good quality mobile travel information technologies to provide users with a wide range of appropriate information-technology services for the full planning, maintenance, support and analysis of travel-based integrated full-featured software and algorithmic applications implemented on a mobile platform.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Researchers and IT companies and corporations are actively working on developing new tools and methods for providing and processing of tourist information and systems to generate personalized problem-oriented recommendations [4-7].

Here are some typical examples of mobile software and algorithmic applications used during the planning and implementation stages of tourist travel.

Travel systems that have gained great popularity among mobile users are so-called computer-guides. Modern tourists need personalized access to comprehensive travel information in any place and any time. Mobile computer-guides are usually created taking into account mentioned requirements [8].

Bright example of such kind of applications is Latvia.Travel, that was created by specialists of the profile organization The Didgital Tourism Tink Tank to meet the information-technology requirements of tourists traveling in Latvia, and according to the peculiarities of this country. Functional mobile application provides tourists providing access to quality tourist information in the realization of the trip. The developers claim that by using the application user gets much more promoted than he expected. Functionally Latvia.Travel can zamictyty a website containing information about the direction and tourist attractions, cafes, restaurants, hotels and events that may be of interest to tourists. [9] Application Developer, Didzisom Spruds, argues that a growing number of users visiting the site Latvia.Travel is using a mobile device. This is yet another confirmation of the need to ensure travelers mobile software applications that can facilitate their information-technology support at home. [9]

Another popular application is Voyager: Route Planner, which was created to provide information technology to help tourists when planning optimal (fastest, minimum cost and so on. Al.) Route consists for travel between multiple destination points of the trip. The system focused on the following groups of users: travelers visiting the various sightseeing attractions; researchers plan to road trip; enterprises engaged in freight and delivery (such as courier / transport of passengers). Feature of Voyager is a mobile application usability and adaptability to use [10].

Mobile information technology is rapidly gaining popularity – a technology of Augmented Reality (Augmented reality, DR). DR imaging technology is based on information provided in the form of text, video, graphics overlay actual images of the object taken with camera mobile device [11].

Famous mobile system additions reality is tourist oriented mobile software platform MobiAR, which is created in the operating environment Android. MobiAR provides users with comprehensive travel information on a certain city or the object, while the tourists have the opportunity to use algorithmic application on mobile devices. The system informs about the events that occurred in the user's location using multimedia content, and access to necessary information when planning tour routes in [12]. The system consists of subsystems registration, user configuration, visualization map of the designation of tourist sites and generating content for each tourist site. Developers using cloud technology to implement communication between the mobile application and knowledge base [12].

Analysis conducted by the authors of paper confirms the fact that the problems associated with the formation of highly efficient high-quality information technology systems and mobile software and algorithmic applications targeted to meet the needs of

modern tourists complete, accurate and quality information on travel planning and implementation are important and actively studied [13].

OBJECTIVES

The main goal of the article is a generalization of intellectual innovation project of information system "Mobile information assistant of the tourist" (MIAT), which provide a full-featured integrated information and technological support to tourists during planning and implementation stages of his journey using a wide range of modern information technologies.

To achieve this goal it is necessary to solve the following problems:

- to analyse of information systems for planning, support and debriefing of tourist trip;
- to identify the main features of the processes of planning and implementation of tourist travel;
- to identify the functionality of MIAT system;
- to identify a package of technical and technological features of this class of systems;
- to identify information resources that will be needed to create MIAT.

The Object of the research is information technology in the tourism industry. The subject of the study is mobile algorithmic applications designed for information technology support of the planning and implementation of the tourism trip. To describe the MIAT system design its developers use methods and tools in standardized UML notation [14].

THE MAIN RESULTS OF THE RESEARCH

A group of researchers from Lviv Polytechnic National University developed innovative technological project of intellectual information system "Mobile information assistant of the tourist" and worked out a prototype of the next-generation integrated mobile computer and algorithmic complex [17].

The aim of this research project is to develop the innovative intellectual software and algorithmic complex aimed to IT support and maintenance of tourist at all stages of his trip (before, during and after its implementation).

So, the initiative of the project is the development of intellectual information system "Mobile information assistant of the tourist" to provide highly professional virtual support to tourist trips to the castle "Palanok" which is located in Mukachevo, the castle in town of Khust (Transcarpathian region) and castles that are included in "Golden Horseshoe of Lviv region": a tourist route that includes a visit to Pidhirtsi, Olesko and Zolochiv castles and also to support tourist during their trip to the center of the city as a historical monument that is a part of the historical heritage, protected by UNESCO [18]. Intelligent information system must be

designed and built in accordance to the information technology slogan "EVERYTHING! HERE! IMMEDIATELY!!!".

Functional features of the system. According to the goals, objectives and proposed content of the project following requirements for functional content of intellectual information system were formed: providing the tourists a consolidated and personalized information at any time, forming personalized routes with the possibility of implementing any changes during the trip, assistance in choosing and reserving vehicles and accommodation, locating and navigating the user during the tourist trip, travel budget calculation, forming the report of spent costs and automatic creation of travel journal, information systems support in off-line mode (Fig. 1) [17].

The main feature of the system is to provide a user with reliable, uncontradictory, full information in accordance with the basic information and technological slogan "EVERYTHING! HERE! IMMEDIATELY!!!". Mentioned intelligent information system should provide tourists with appropriate comprehensive IT support at anytime and anywhere [17]. There is no doubt that the system in the final embodiment must satisfy the requirements of the usability and aesthetic presentation.

The main user of the system is the average tourist with his real requests for information, specific preferences, tastes, character, attitudes and needs. Moreover, the functionality of the system must give the opportunity for planning and information-technological support of the group (family) tourism trip. The possibility of using the information system by different classes of users is shown in Fig. 2.

Expert and system administrator are responsible for the proper functioning and correct filling of data base (DB) with tourist information and knowledge bases (KB) with training examples. Further knowledge base updates automatically during interaction sessions with the tourist system.

Technical and technological features of MIAT. MIAT – is a complex structure of software and algorithmic complex that 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 hardware system is a powerful mobile device with GPS antenna and the ability to connect to the Internet (see Fig. 4.).

Architectural design of this software and algorithmic complex involves locating “system engine” on the mobile device to make the realization of the off-line mode possible (see. Fig. 3).

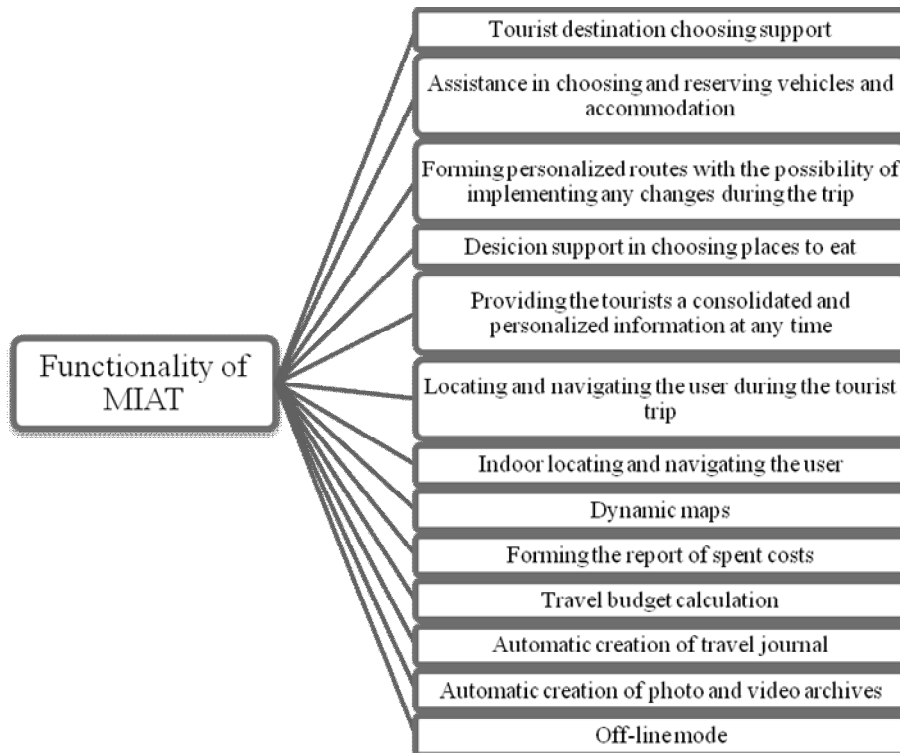


Fig. 1. Functionality of MIAT *

* Self developed

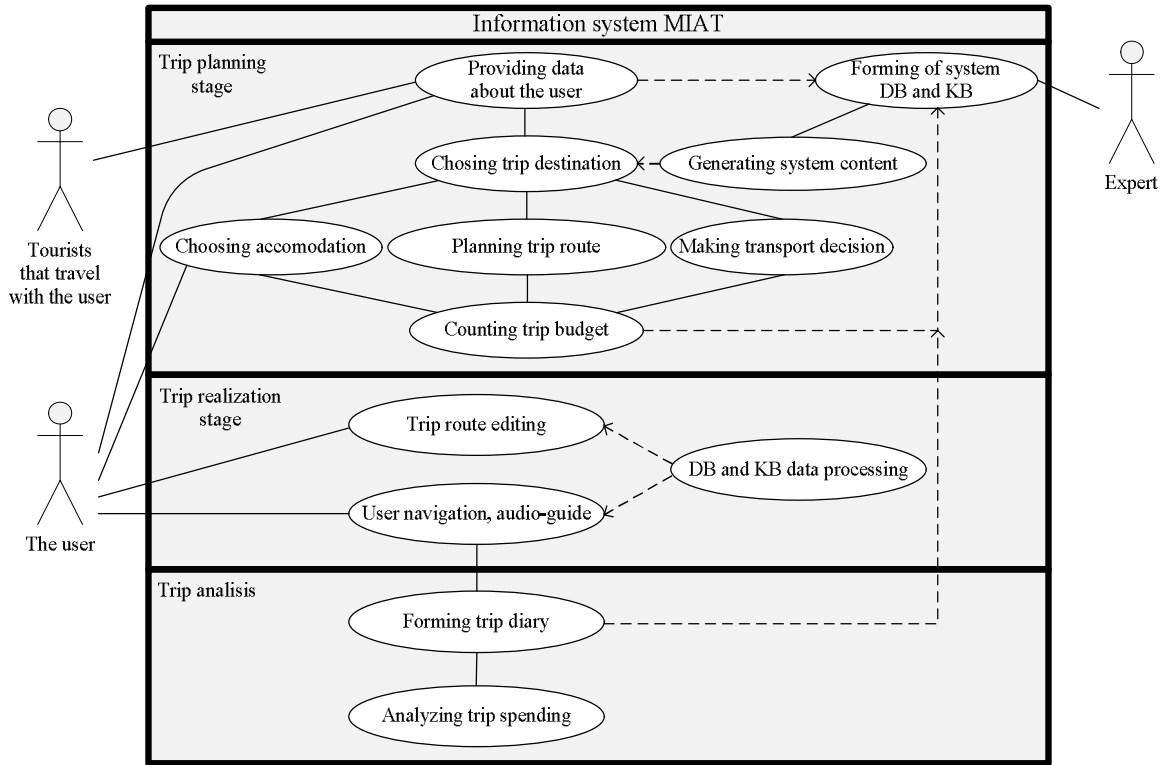


Fig. 2. UML use-case diagram. The roles of the users of MIAT*
 * Self developed

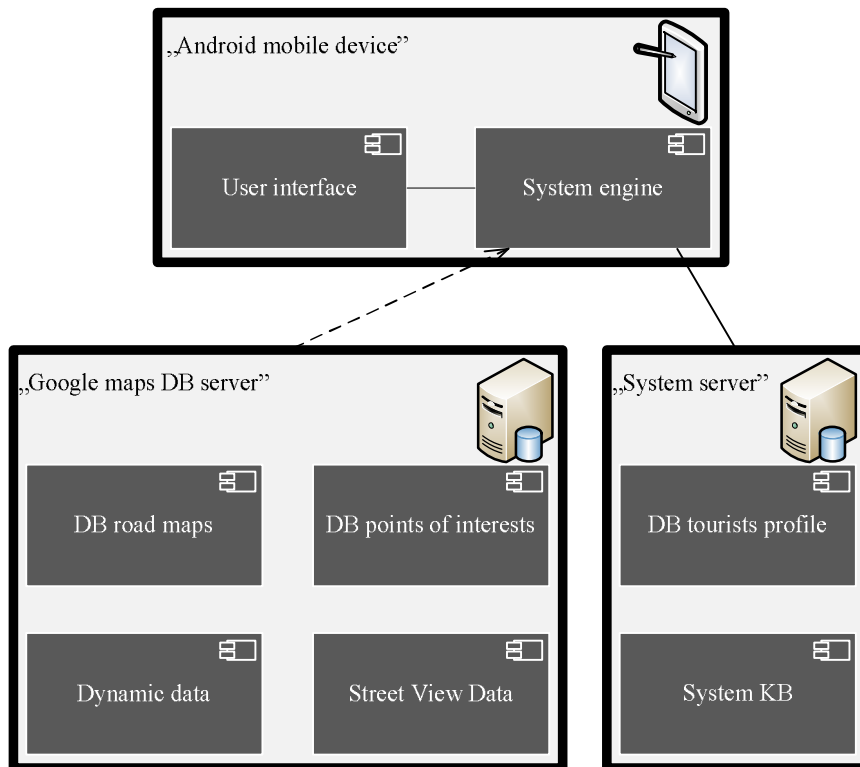


Fig. 3. UML deployment diagram. General architecture of the system*.
 * Self developed

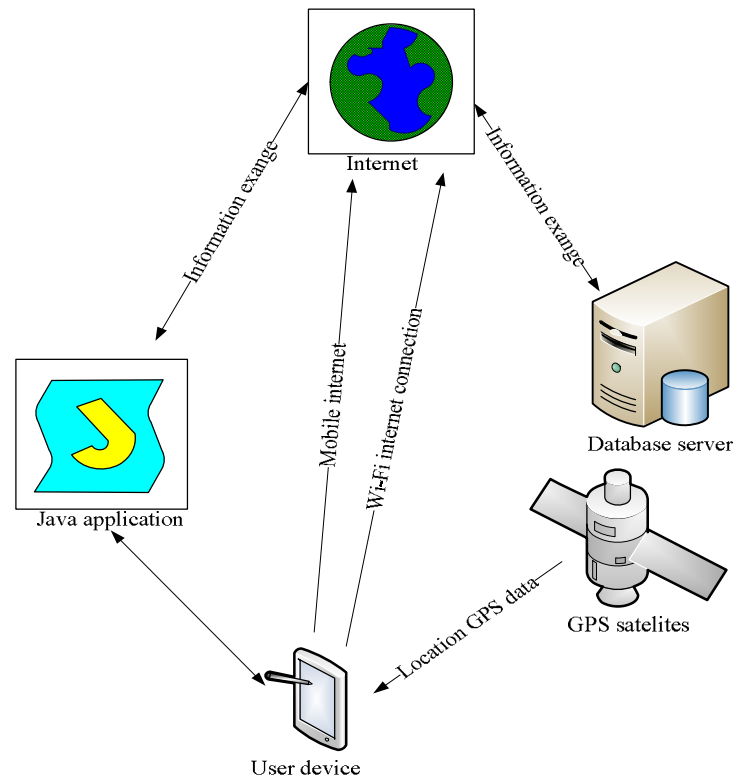


Fig. 4. Hardware of the system designed by Savchuk
* *Self developed*

The data base and knowledge base of system is located on a separate server and when planning the trip needed data is saved directly on the mobile device.

In addition, the MIAT system is going to use Google Maps service in order to add necessary tourist map information. The authors have selected this service because of its powerful algorithmic information content and functionality. Google Maps service includes a set of databases that are based on the free map service and technology provided by Google. Service enables cartographic data and satellite images of the earth's surface, and provides access to the integrated directory "points of interests" (POI) and maps of roads, with the function of optimized routes search [19]. It should be specifically highlighted the subsystem «StreetView» specified service that provides a spherical images of streets of cities in Ukraine and worldwide [20]. All relevant data are on the server (see. Fig. 4).

The system engine is described separately in the Fig. 5.

It contains the following components:

- *User poll* – this component is responsible for the survey, and formation of the user profile information, records obtained personal data to the system data base.
- *Decision support subsystem* – the component that is responsible for assisting the tourist in making

such decisions as choosing the accommodation and transport, places to eat and POI to visit. In addition to this the component will give an opportunity to make reservations and buy tickets to different facilities.

- *Panning tourist route* – this intellectual component has is responsible for a personalized travel planning optimal routes according to the results of the survey, decision support subsystem and the possible duration of tourist trip. An additional feature is the ability to change components of the tourist route during the trip, depending on the wishes of the current user and information about its location.

- *Forming DB and KB* – this component is responsible for adding new information to the system.

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

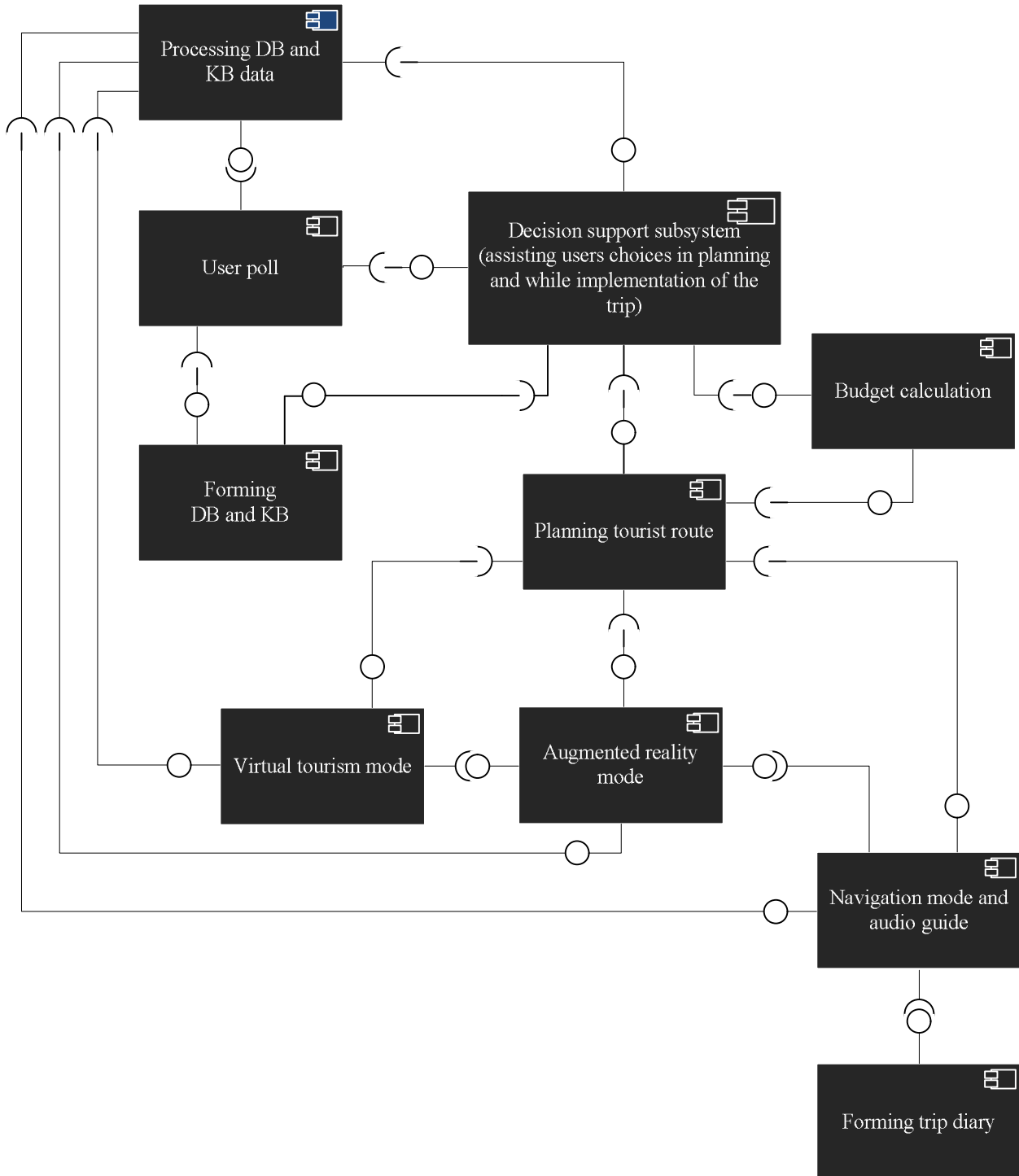


Fig. 5. UML component diagram. The architecture of system engine designed by Savchuk
* Self developed

- *Processing DB and KB data* – the component, that processes DB and KB data according to the inputted query. The output of the component is information that is needed for functioning of other components or directly for the user.
- *Augmented reality mode* – a component that will implement the operation augmented reality mode during a

trip. It means that the video and pics from the camera in users mobile device in real-time is processed and tag 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 mobile are placed under the taken picture.

- *Virtual tourism mode* – a component that is responsible for obtaining data on the planned route of subsystem «StreetView» of GoogleMaps service (see. Fig. 3) and sending them to the components of the "Augmented reality mode" to be used instead of the images obtained by a camera device. As a result, the user will be able to see the pre-planned tourist route on your mobile device.

- *Budget calculation* – a system component that is responsible for the preliminary calculation of the planned trip budget and forming report on costs spent during its implementation. It uses data on cost of living, vehicles, food (the user is offered to provide a report on the funds spent in catering establishments), entertainment and so on.

- *Forming trip diary* – a component that is responsible for the preservation, sorting and forming the description of the data generated and activated during the trip, such as maps of routes traveled, photo, video files, and information on geolocations.

Processes of users interactions with the system.

First of all, after starting the system takes on your mobile device a request for authorization or user registration. User registration involves entering the email address and password, and tourist potential responses in the survey designed to determine the travel profile. Obtained registration in the presence of personal data Internet communications are recorded in the database, containing information about tourist tourists (see. Figure 3-5).

Authorizations user provides input your email address and password, then they are checked for conformity and resemblance to the patterns and standards. When using email, which is connected to the mobile device operating system, authentication occurs automatically when the relevant connecting to the Internet.

Planning tourist trip. After completing the registration / authentication, the user, if a travel plan it is proposed to choose a personalized list of tourist destinations, which sorted in order according to the user profile and time of the visit (Every tourist destination has specific advantages seasonal). All items of the list are accompanied by detailed tourist information tourist destination and its features. The user must choose the most appropriate for a tourist destination.

After that the tourist has the opportunity to choose and book and vehicles, and plan travel routes and calculate the necessary budget travel realizing these steps in an easy to order it.

When planning the tourist route the user is given a list of tourist sites to visit with detailed information

about each of them, as well as personalized tours created taking into account user preferences and duration of travel. The user must choose the most interesting tourist attractions. Under this proposed system adjusted routes. In case the customer is satisfied with the result, information on the planned route is stored for later use and changes during the realization of the trip.

When choosing a place of residence to provide users with a personalized list of hotels, motels, campsites and apartments for rent and redundancy detailing the location, conditions and prices. When choosing a place of residence registration the user the opportunity to request a reservation concerning habitats. Reservations vehicle is a similar procedure.

The calculation of future travel budget based on past actions and is approximate.

In addition to planning a travel proposed implementation of virtual tour on your mobile device to review previous user's tourist routes. Virtual tour implemented using a separate system components MIAT (see. Fig. 5).

After downloading the "Virtual tourism mode" user to plan a route for travel, select a saved route or choose the starting point of the virtual tour on the map. Then the system loads the appropriate data service «Google StreetView», namely spherical images of streets and tourist sites and tourist route chosen direction.

Further loaded component "Augmented reality mode" that provides information generating tags and their corresponding overlay image objects. It is proposed to use the following types of information labels:

- recommended direction indicators;
- orientation map (pointers of center or famous tourist sites location);
- information on objects that are in close to the user.

Supporting the user during the trip. The most important and meaningful application of perspective is the practical use of MIAT during implementation of tourist travel. First of all, the user gets the opportunity to plan future actions at any convenient time, and secondly tourist ensured constant IT support during the exercise of the trip.

After starting the system the user needs to go through the authorization or registration, as described above. Provided that the trip has been planned program displays previously saved tourist route on the user's mobile device screen indicating the location of the user. If the trip is not pre-planned, the system displays a map according to the location data of the tourist.

For determining the place of residence is responsible component "Navigation mode and "audio

guide" system engine (see. Fig. 4). To determine user location using GPS positioning technology, GSM and Wi-Fi networks [19].

In addition to dynamic map system designated place, located next to the user and his might and provided detailed travel information about each of them.

At any time the user can create a request for withdrawal of the necessary data, such as information about recommended places food, entertainment, etc., and change the planned route.

Anticipated development of tourist guide mode, providing the user navigate through the travel direction and sounding more information about the tourist facilities are nearby.

Augmented reality mode technology is the most difficult in algorithmic implementation and organizational support. The specified mode is implemented based on this information technology:

- machine vision technology;
- images and video processing technology;
- positioning technologies based on GPS and digital compass;
- texts processing technologies.

After selecting a user profile additions reality loaded on system components. Operation mode additions reality essentially depends on the results of the components of the Navigation and "audio guide".

Following booting the system and information technology components of the data processing to determine the user's location and fixed line "view" photo / video camera device, and the analysis of data availability additions reality on given situation. Next stage after generating relevant information tags are superimposed on the camera image obtained mobile device.

The user can at any time choose to change the type or mode of use of additions reality: standard or "audio guide". When choosing the type of "audio guide" system loads the planned or optimal travel itinerary and visit tourist object (for example, the castle, museum, etc.). After the selection is generating information about objects that are in "sight" camera on his mobile device screen displays tag information", and detailed information is made public. Regularly check is the location of the user and the direction of "sight" camera mobile device to provide comprehensive relevant tourist information.

In augmented reality usual user chooses the direction of motion, and the system provides information based on the data obtained from the camera device. To clarify the information on certain tourist sites the user can form in response to a request that will receive information in the format text, photo, video and audio that are displayed under the screen of the device.

Augmented reality mode is designed to improve the completeness and amenities provide tourist information

on tourist routes, facilities and areas for better assimilation and acceptance by the user, the quality and precise location on map user, including versions of his time indoors and buildings.

The result of the research made by the group of researchers of the University "Lviv Polytechnic" is the project of innovative intelligent system "Mobile information assistant of a tourist" oriented on IT support of the user in planning and realization of his/her tourist trip in accordance with information technology slogan "EVERYTHING! HERE! IMMEDIATELY!!!".

The aim of the research project "Mobile information assistant of a tourist" (MIAT) is developing the intellectual innovative software and algorithmic complex to provide IT support and maintenance to tourists at all stages of the trip (before, during and after its implementation).

System requirements and its functional features are formed as a result of the analysis of up-to-date researches in the field of mobile information technologies in tourism, and the needs and problems faced during a tourist trip. According to this goal, the authors analyzed the processes of planning and implementation of tourist travel in terms of project management methodology [17].

System architecture and its engine are designed and presented graphically, the role of major classes of users is distinguished and the processes of user interactions with the system that depend on the goal are described.

The main users of the system are ordinary tourists, while there are opportunities to provide information technology support for family and group tours, taking into account the individual characteristics of every traveler.

The system has quite complex structure and extensive architecture. It requires serious technical, program and algorithmic information tools and resources for full implementation. Its main components and functions are database and knowledgebase, navigation and mode "audio guide" planning travel routes, virtual tourism mode, additions reality mode, budget calculation, decision support subsystem and others. The structure allows timely and high quality processes to generate recommendations to the user and provide support at all stages of the trip.

The proposed implementation of the processes of interaction of tourists with the system aims to ensure high quality and usability of MIAT for both simple and advanced users of mobile applications.

The article contains description of the project innovative intelligent system "Mobile information assistant of a tourist". The analysis of functional and technological features of the system, the purpose and content of the main stages of its implementation was made.

Nowadays, individual components of the city, its database and knowledgebase are being designed. The

above functionality requires the formation of high-quality information resources on which developed the database "places of interest", "road maps" knowledge base and decision support subsystem that contains personalized information about users.

CONCLUSIONS

The result of the research made by the group of researchers of the University "Lviv Polytechnic" is the project of innovative intelligent system "Mobile information assistant of a tourist" oriented on IT support of the user in planning and realization of his/her tourist trip in accordance with information technology slogan "EVERYTHING! HERE! IMMEDIATELY!!!".

The article contains description of the project innovative intelligent system "Mobile information assistant of a tourist". The analysis of functional and technological features of the system, the purpose and content of the main stages of its implementation was made.

The priority tasks facing the developers of the system at the next stage of its creation is to develop basic algorithms of the system, including algorithm for optimal personalized route planning, algorithms for generating personalized information, calculating the exact location, algorithms for automated formation of the travel diary, navigation, calculating budget of the trip, etc.

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