Mobile Application for Guiding Tourist Activities: Tourist Assistant – TAIS

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***Abstract*—The paper presents category classification of mobile travel applications accessible at the moment for tourists in application stores for most popular mobile operation systems (Android and iOS). The most interesting category is "Travel Guides" that combines "Information Resources" and "Location-Based Services" category. Authors propose application "Tourist assistant – TAIS" that is related to "Travel Guides" category and recommends the tourist attractions around. Information about attractions is extracted from different internet sources.**

I. INTRODUCTION

The modern Internet provides tourists with huge possibilities for searching interesting information and planning their activities. Recent developments of information and communication technologies allow tourists to get interesting information via the Internet during their trips. Smartphones are mainstream in this area with active iOS and Android devices surpassing 700 million globally by now. Global Mobile data traffic is growing rapidly to an impressive share of 13% of the Internet traffic in 2012 [1]. In accordance with [2] about 50% of existing tourism recommender systems is designed for mobile devices. As has been the case with other information and communication technologies, tourism has manifested as one of the most well suited sectors to mobile technology and mobile applications [3]. There are a lot of services and applications that allow simplifying this search, proactively providing information about interesting attractions, user feedback, etc. In accordance with [1] at the moment German Apple Store accounted around 780.000 apps and 36.000 travel apps (category Travel) representing a market share of 4,62% of all available apps.

Classification of mobile applications accessible in tourism sector (adapted from [1] and [3]) is presented in Fig. 1. There are four main mobile travel applications categories: "Online Booking", Information Resource", "Location-Based Services", and "Trip Journals". Applications from "Online Bookings" category allow a tourist to make online reservations for different services (e.g., car rental, hotel, airplane ticket booking). Usually the tourists demand applications from this category before the trip. Applications from "Information Resources" category provide the tourist a useful information during his/her trip (e.g., information about tourist destination, flight tracking, information about the airport and services accessible). Applications from "Location-Based Services" category provide the tourist context-based information based on his/her location (e.g., map and navigation services, services that provides information about hospitals, police phones). Applications from "Trip Journals" category allow the tourist accumulate and analyze information related the trip (e.g. calculate money spent for the trip). Three subcategories incorporate several categories: "Travel Guides", "Tour Operators", and "Hotel & Hotel Chains". "Tour Operators" as provide information about tours, air companies, hotels, etc. as alows to make online reservations of preferable tour. Applications from "Hotel & Hotel Chains" as provide the tourist hotel description as provide possibility to book the hotel. "Travel Guides" provide region specific information based on the tourist location. It is the most interesting category that combines "Information Resources" and "Location-Based Services" categories.

In accordance with [4] mobile travel guides have to provide context-dependent, multimedia-rich touring services for visitors. Authors propose in the paper an application "Tourist assistant – TAIS", which is related to "Travel Guides" category and recommends the tourist attractions around based on his/her preferences and context situation in considered area. As information sources it has been proposed to use different accessible Internet sources (like Wikipedia, Wikivoyage, Panoramio) that provide actual and comprehensive text and multimedia information about different places of interests.

Based on the analysis of information acquired from the tourism information center of Karelia region[1] [5] the following major issues for a tourist arise when he/she comes to a region: information needs, transportation possibilities, intelligent guides. Information needs issue includes tourist greetings with essential information of the region (e.g.,

[1] http://www.ticrk.ru/en/

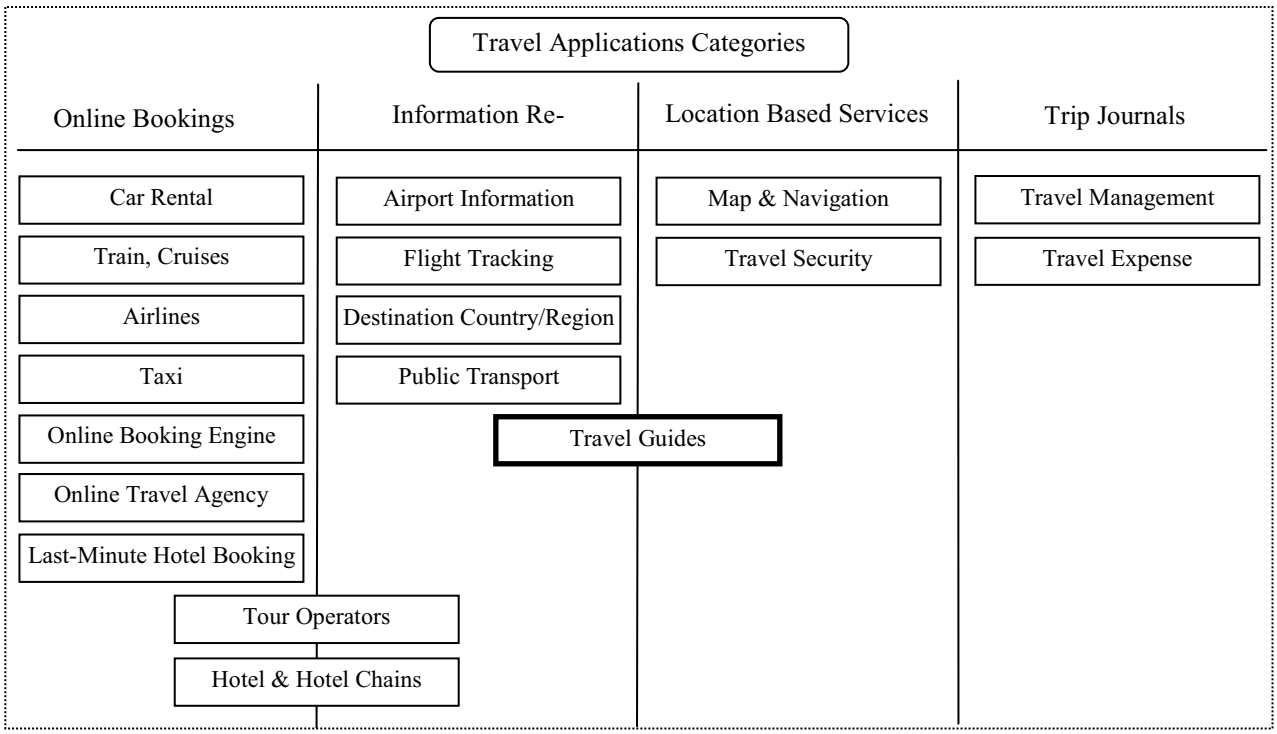

Fig. 1. Classification of Mobile Travel Applications

police and ambulance phones, consulate or embassy contact information); the main country laws and regulations (e.g. smoking and drinking is prohibited in public areas, regulations for attending churches, taking photos of government building); region specific information (e.g., how to use public transport, left-hand drive or right-hand drive); tourist safety information with description the most popular incidents when a tourist can lose his /her money.

Transportation possibilities issue includes public transport schedule, interactive map, routing; taxi phones; ride-sharing possibilities. Intelligent guides issue includes: information about attraction and places of interests; suggestions which attraction is better to attend and how to reach it, based on tourist preferences and current situation in the region.

The rest of the paper is structured as follows. Section II presents an overview of existing at the moment mobile e-Tourism solutions. Description and evaluation of mobile travel guide "Tourist assistant – TAIS" is given in Section III. Main results are summarized in Conclusion.

II. Related Work

Table I shows a list of mobile e-Tourism solutions that have been identified as most interested for providing a tourist services during his/her trip. Presented solutions are related to "Information Resources" and "Location Based Services" categories that is the most interesting for development form scientific point of view.

Authors of [2, 4, 6] present a comprehensive analysis of intelligent tourism recommender systems. They classify systems by recommendation methods, interfaces, user preferences representation and etc. But did not give consideration (or give it superficially) to information sources, which is used for providing tourists with information about interesting places. Most of considered systems use predefined databases, which include information about attractions

The carried out analysis of the mentioned above systems shows that they can be divided into two main groups for information extraction:

- applications that implement search for information around the tourist from Internet sources;
- applications that have own databases with information about attractions and provide this information to the tourist.

Applications from the first group require the Internet connection while applications from the second group can provide the tourist information independently. The main disadvantage of the first group applications is a high price for mobile roaming and usual tourists cannot use Internet connection during the trip. However, governments of different countries plan legislative regulations to reduce roaming prices [7]. The main advantage of first group applications in compare with the second group is possibility get up-to-date information around the tourist independently on the tourist location. In addition, it is not needed to keep a big database with information about attractions in the tourist mobile device.

TABLE I. MOST INTERESTED MOBILE E-TOURISM SOLUTIONS

	Name and Link	Description	Platform
1.	PSiS [8]	PSiS is a tour planning support system that aims to provide the tourist a visit plan combining, in a tour, the most adequate tourism products, namely interesting places to visit, attractions, restaurants and accommodation, according to tourists' specific profile (which includes interests, personal values, wishes, constraints and disabilities).Functioning and transportation schedules are also considered to generate a tour planning. Before the trip a tourist interacts with the system through the special web application and during the trip it is possible to use the special mobile application for Android-based smartphones.	Android OS Web application
2.	GuidiGO https://www.guidigo.com/	Personal world-wide tour guide. It allows to get an experience about destination, by downloading guided tours created by local experts and passionate storytellers around the world. It is possible to choose a tour based on the tourist interests: history, architecture, art, fashion, etc.	iOS Android OS
3.	Viator Tours & Activities http://www.viator.com/	Mobile application that allows to find and book tours and activities in destinations worldwide. Viator's local experts plus reviews and photos from travelers provides insider experience.	iOS Android OS Web application
4.	COMPASS [9]	A mobile application for tourists COMPASS is an application that makes context-aware recommendation based on tourist's interests and context. The application is built upon the WASP platform that provides generic supporting services combined with semantic web technology.	
5.	Dynamic Tour Guide [10]	Context-driven mobile tourist guide that has been developed for Windows Mobile operation system. The study presents methodology, implementation and evaluation of mobile tourist guide.	Windows mobile
6.	Go!Tour [11] https://play.google.com/store/apps/details?id=com.loyaltyplant.partner.gotour	Android-based mobile application for providing tourism and geographic services in Istanbul city. Application has internal attraction database and provides possibilities of searching places of interests around using the Variable Neighborhood-based algorithm.	Android OS
7.	World Around Me [12] http://oss.fruct.org/wiki/KA117-wam	Windows Phone 7 application that shows the user photos around the user location. Photos are automatically downloaded from Flickr and Panoramio and presented to the user.	Windows Phone 7
8.	ImogI [13] http://research.edm.uhasselt.be/~imogi/	Context-aware mobile guide for outdoor as well as indoor locations. It uses GPS to identify user's location in out-door environments, communicates with other objects in the environment through Bluetooth. The information that is shown in the user interface can be obtained in two different ways: stored on the mobile guide, or queried from the artifacts that are in the direct surroundings of the mobile guide through wireless communication.	Windows Mobile
9.	Triposo http://www.triposo.com/	The travel guide Triposo is a free mobile guide service available for Apple and Android devices. A user can download the application and appropriate database (which is updated ones each two months) to the mobile device beforehand and use it during the trip without Internet connection. The application supports logging of trav-elling. It includes databases from the following sources World66, Wikitravel, Wikipe-dia, Open Street Maps, TouristEye, Dmoz, Chefmoz and Flickr. Each guide con-tains information on sightseeing, nightlife, restaurants and more.	iOS Android OS Nokia Ovi Store
10.	TripAdvisor http://www.tripadvisor.ru	Millions of traveler reviews, photos, and maps can be accessible in TripAdvisor. Tourists can plan their trips taking into account over 100 million reviews and opinions by travelers. TripAdvisor makes it easy to find the lowest airfare, best hotels, great restaurants, and fun things to do, wherever you go. The mobile application is free, it supports all mobile platforms.	iOS Android OS Nokia Ovi Store Windows Marketplace Web application
11.	Smart Travelling http://www.smart-travelling.net/en/	Online travel guide that supports about 30 cities world-wide including the most interesting destinations in European countries and USA. The guide includes a database of restaurants, cafes, hotels, shopping-tips and other places of interests. The mobile application for iPhone is accessible in AppStore. Integration with Google maps allows user to see the current location in the map and helps to navigate to each and every tip in destination cities. Application allows the user to down-load the content and use guide without Internet connection.	iOS
12.	ARTIZT [14]	Innovative museum guide system, where a ZigBee protocol is used for determine user's position information. Visitors use tablets to receive per-sonalized information and interact with the rest of the elements in the environment. The system achieves a location precision of less than one meter. The context is used to provide needed at the moment personalized information to the user.	Prototype

The following groups of applications have been identified based on travel phases (most of applications covers two or all travel phases):

- pre-travel phase, that provides range of services to facilitate travel-related information search, for instance attractions description, hotel and airplane booking, and etc.;
- travel phase, that provides the tourist real-time information about the destination, e.g. information about events, places of interest, advices, and practical recommendations;
- post-travel phase, try to get feedback from the tourist (variety of solutions to collect estimation information about attraction) and share his/her travel experience with others.

The first applications group applications provide the tourist possibility to plan his/her trip, get information about attractions for given destination, book hotels and flights. Applications from the second group provide the tourist personalized context-based information about attraction in destination. The aim of applications from the third group is to collect posts, photos, videos, and/or estimations about attractions attended by the tourist. This information can help other tourists to decide if he/she would like or not to attend this attraction. There are applications that incorporate two or all three groups (e.g., Tripadvisor allows to plan the tourist trip by browsing information in PC before).

During the trip, the tourist can use mobile application to see places of interests around. In addition, Tripadvisor allows to make estimations about attended places of interests and post some blogs about them.

III. TOURIST ASSISTANT – TAIS

A. Application description

Tourist assistant – TAIS is a mobile application, which is related to the "Travel Guides" category (see Section 1) and has been developed based on Smart-M3 platform [15], that makes possible to significantly simplify further development of the system, include new information sources and services, and to make the system highly scalable. The key idea of this platform is that the formed smart space is device, domain, and vendor independent. Smart-M3 assumes that devices and software entities can publish their embedded information for other devices and software entities through simple, shared information brokers. Platform is open source and accessible for download at Sourceforge[2].

Implementation of tourist assistant – TAIS application has been developed using Java KPI library[3]. Mobile clients have been implemented using Android Java Development Kit[4]. The application consists of a set of services [17] that interact with each other for providing the tourist recommendations about attraction that is better to see around. There are client application, attraction information service, recommendation service [18], region context service, ridesharing service [19], and public transport service.

The main application screen is shown in Fig. 2, left screenshot. The tourist can see images extracted from accessible internet sources around, clickable map with his/her location, context situation (weather), and the best attractions around ranked by the recommendation service. When the tourist click to an attraction the following context menu is opened (see Fig. 2, right screenshot). The tourist can see detailed information about the chosen attraction (Fig. 3, left screenshot), browse attraction reaching path that is proposed by the system route to an attraction (Fig. 3, right screenshot), and/or estimate it (Fig. 4, left screenshot).

Detailed information about attraction contains a list of images that is associated with this attraction and it description. This information is extracted by the attraction information service from different internet sources (e.g., Wikipedia, Wikivoyage, and Panoramio are used at the moment).

The tourist has possibility to estimate images using the following options: "like image", "dislike image", "this image is not applicable" to the attraction (see Fig. 3, left screenshot). Based on these estimations the recommendation service will re-order images for this or another tourist next time.

The tourist can browse the attraction reaching path by choosing "Show on the map" item in context menu (see Fig. 3, right screenshot). The routing service that is responsible for calculating attractions reaching path based on developed OpenStreetMap-based web mapping service [20]. Routing service provides the tourist possibility to build pedestrian path, find fellow travelers who go to the same direction [19], and find public transport to reach chosen attraction.

For searching public transport, the Yandex.Schedule API has been used. It allows finding transport threads between the settlements using the following functions:

- Nearest station search for finding public transport stops near the current tourist location.
- Searching routes schedules by the station.
- Searching routes schedules between stations.
- Searching route stops that allows showing all stops by the queried route.
- Searching information about carrier.

For building attractions reaching path by public transport the routing service uses two of the presented above functions: nearest station search and searching routes between stations. When the server finds request for transport search, the first function searches station in the areas of the tourist current location and the attraction location. Then the second function searches the transport threads between found stations. Search result are sorting by the departure time and shows to the tourist.

[2] Smart-M3 at Sourceforge, URL: http://sourceforge.net/projects/smart-m3
[3] http://sourceforge.net/projects/smartm3-javakpi/
[4] http://developer.android.com/sdk/index.html

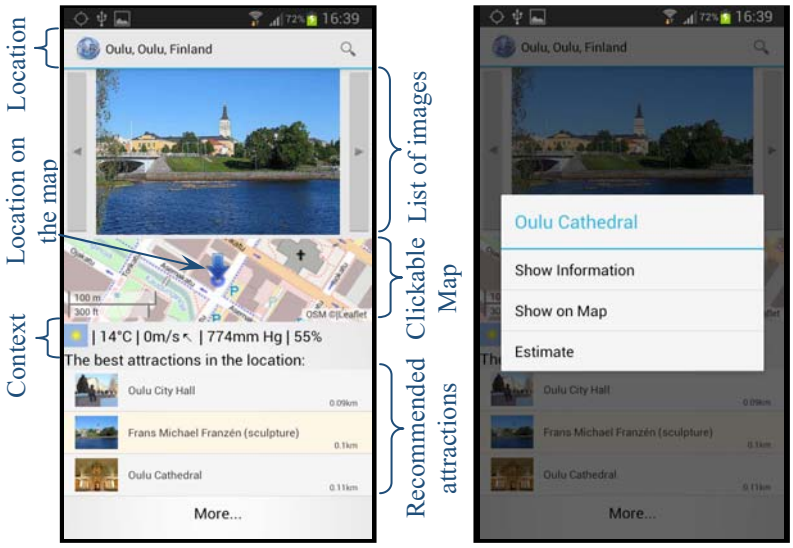

Fig. 2. Tourist assistant screenshots: main screen, context menu with actions

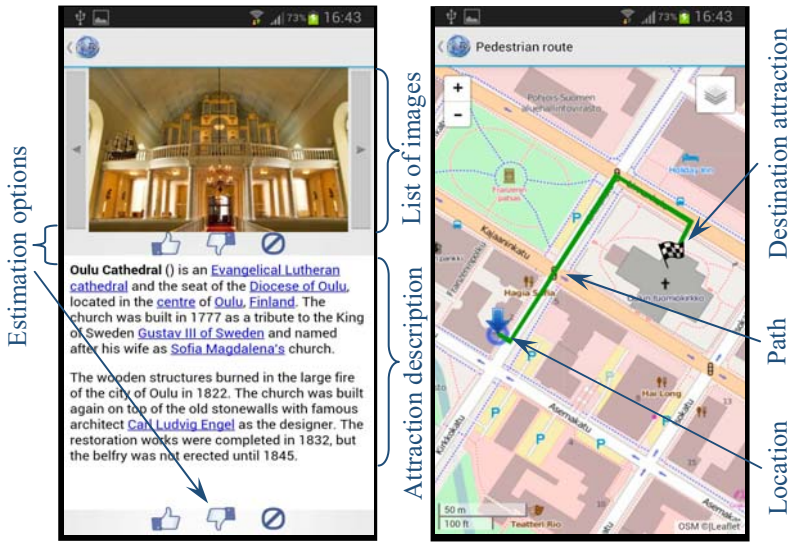

Fig. 3. Tourist assistant screenshots: attraction details and route to the attraction

Tourist can browse information about the best attractions around presented by the mobile tourist guide in the main screen and click button "More" to see more attractions (see left screenshot in Fig. 4). The tourist can estimate is an attraction is interested or not by look through it name and image. If he/she would like more information, it is possible to open description window (Fig. 3, left screenshot). Also tourist assistant calculates distance to every attraction (see Fig. 4, left screenshot).

The tourist can estimate the attraction if he/she like or dislike it (see Fig. 4, right screenshot). For this purposes he/she specify the context (company and weather) and make the estimation using five scale rating.

By pressing "menu" button guide application allows to search information for worldwide attractions by choosing another area (country, region, and city) and access the settings page of the mobile tourist guide application. In the status bar, the tourist can search for attractions worldwide.

B. Evaluation

Implementation of the application shows that it is applicable to the considered domain. Tourist assistant response time not more that few seconds for every operation. For example, for the center of St.Petersbug (Vasilyevsky Island area) recommendation of attractions use case takes about 3 seconds for the acquiring (2,9 sec), ranking (0,1 sec) and providing to the tourist up to 50 nearest attractions.

The most of this time is spent on acquiring a list of attractions nearby the tourist. In the considered example, the online Wikipedia is used as an information source. In case of using dump of information from Wikipedia, this time can be significantly decreased.

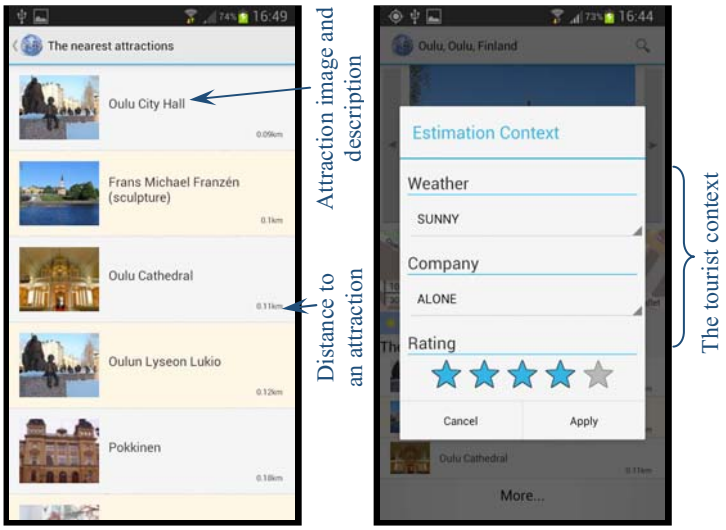

Fig. 4. Tourist assistant application screenshots: all attractions around and estimation attraction interface

TABLE II. HARDWARE CHARACTERISTICS FOR EXPERIMENTS

Characteristic name	Characteristic value
Host operation system	Windows Server 2008
Hypervisor	Hyper-V
Virtual operation system	Debian 7.6 64 bit
RAM	1,4 Gb
CPU	Intel Xeon CPU E5620 @ 2.4 GHz
Allocated CPU cores	1
Network Type	Ethernet
Network Speed	1000 Mbit/s

The dependency of query transaction execution time based on increasing of number of tourists is presented in Fig. 5. For the experiments, a test application has been developed that generates triples that describe tourists in smart space (one tourist is described by approximately 30 triples) and calculates query & insert transaction execution time. Insert transaction execution time does not depend on count of triples in smart space while a query transaction has a linear dependency (see Fig. 5). One thousand tourists is described by approximately twenty-seven thousands of triples and one thousand of subscribe transactions. For this count of triples and subscribe transactions response time of Smart-M3 platform is approximately 0.3 seconds. For the experiments the following computer is used (see Table II).

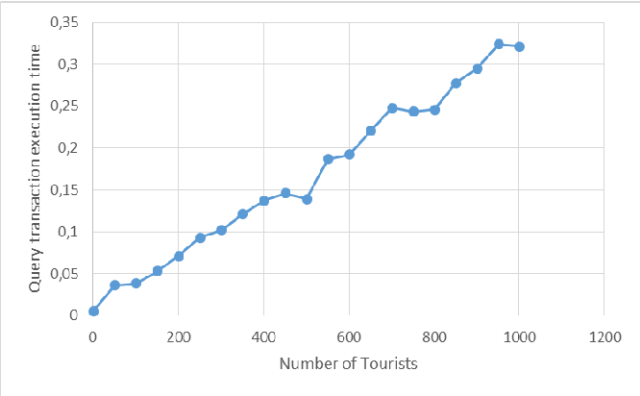

Fig. 5. Query transaction execution time dependency on number of tourists in Tourist Assistant – TAIS

IV. CONCLUSION

The developed in the paper classification of mobile travel applications allows to classify a lot of travel-related applications as described in the scientific papers as accessible in Google Play Market, Nokia Store, and Apple Store repositories. Category “Travel Guides” that combines “Information Resources” and “Location-Based Services” categories has been identified as the most interested from scientific point of view and demanded in the market. Presented in the paper analysis of similar systems shows that tourist has to be guided in the three phases: before the trip, during the trip, and after the trip.

Authors propose application “Tourist assistant – TAIS”, which is related to “Travel Guides” category and generates recommendations for the tourist about interesting attractions around. The main differences of presented application from existing in repositories is extraction of information about attractions from different internet sources that allows the tourist to get up-to-date information and does not require to download attraction database before the trip.

Application consists of several services that joins for solving the tourist task. For interoperability support between these services the smart space technology is used, which allows providing for ontology-based information sharing between different devices.

Evaluation shows that developed application is applicable to the considered domain. Experiments for the center of St.Petersbug shows that recommendation of attractions use case takes about 3 seconds for providing the tourist up to 50

nearest attractions. For testing application behavior for the big amount of tourists the experiment has been conducted. The experiment shows that for the 1000 tourists Smart-M3 platform query response time is approximately 0.3 seconds. That time is insignificant and shows that smart space technology can be successfully applied for such kind of applications.

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