

Smart Tourism Destination Support Scenario Based on Human-Computer Cloud

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Abstract—Nowadays tourism has become one of the fastest growing economic sectors. It leads to growth of investments and people involvement in tourism infrastructure development. One of the results of this process is an appearing of smart tourism destinations that increases the quality of tourist experience in the destination with smart support. Smart destination exploits human-computer cloud technologies providing personalized support for tourists. The paper proposes a working scenario of a smart tourism support system with usage of volunteered geographical information sources as main data sources. The scenario example has been shown on base of the tourist assistant – TAIS.

I. INTRODUCTION

Nowadays tourism has become one of the fastest growing economic sectors. By the report of the World Tourism Organization (UNWTO) the number of tourist arrivals had increased by 4.6% (or by 52 million people) for the year 2015 [1]. By the forecast of UNWTO, the number of tourist is expected to increase by an average of 3.3% a year over the period 2010 to 2030. Taking into account that tourism is considering as a main category of international trade in services, this will lead to growth of investment in services, that are developing for tourist needs, like new hotels, galleries, tourist centers, software application, etc. New investments are creating new work places and drives new people to take part in the tourism infrastructure development.

At the same time, the significant development of information technologies introduces new paradigm – smartness – to all spheres of human life. Many services have been developed for providing support for citizens and enchasing the control under cities development while creating technology-embedded ecosystem of Smart City. In tourism perspective services, in combination with cloud computing, human cooperation and Internet-of-Thing technologies, can improve the effectiveness of tourism resources management throughout the destination and provide so-called “smart tourism destination” [2], [3].

The way of people can be involved in creation of smart tourism destination includes the development of information services, suitable for tourist support while planning trip and during the trip, as well as content creation for the services. These services are aimed for ticket searching or hotel booking, location and navigation support, searching nearest attraction places and information about them. This paper is aimed on the

last kind of services that is also called “intelligent tourist guide”.

Intelligent tourist guides have been proposed to collect information from internal database or distributed sources in the Internet, combining them on the tourist’s mobile device to assist them in the decision making process in destination. Usage of internal database is suitable in situation of unavailability of internet connection, but it needs data have to be prepared and downloaded to the user device before the trip. In that case developers of the intelligent tourist guides should prepare and distribute databases that contains a great amount of information about attractions in the main tourist places (like descriptions, photos), cities transport systems, etc.

The other way of providing information by intelligent tourist guides is a gathering data from various Internet services. Many tourist services have been developed by now. Tourists can create plan of the future trip, book tickets and hotels, check information about attractions that are recommended to visit. Intelligent tourist guides combine these separate services in one real-time service. Against to the usage of internal database, information should not be prepared before the trip and guide developers are free to choose what service will be used to provide information depending on current situation. Since one of the main tourism purposes is an exploring of interesting places, the most often used services are services provided by geographical information systems (GIS), like mapping, geocoding and geotagging.

GIS services should collect and operate a great amount of spatio-temporal data. In the past 10 years significant attention from all consumers of geo-spatial data have attracted to collaborative mapping projects like OpenStreetMap [4] (OSM) or Wikimapia [5]. Geographical information received by these projects is also called Volunteered Geographical Information (VGI) due to the voluntary approach for data collection. In application to tourism, usage of such approach allows to involve local communities in creation of tourist information about region [6]. It should also be mentioned that not only local community but also visitors could generate VGI about visited places, like photos, reviews, ratings, and advises. For this purpose, they need a platform that allows to share and process such kind of information.

The paper proposes a scenario of smart tourism destination support with usage of social and computer units that are organized in human-computed cloud to create a content,

process it, and provide support to tourist. The idea is to apply the distinctive features of cloud computing (namely, resource virtualization, abstraction, and elasticity) to the construction of information processing systems containing hardware, software, and humans [7]–[9]. The scenario is implemented on the base of tourist assistant — TAIS [10] with usage of Geo2Tag platform [11] to provide a storage for volunteered geographical information from Wikimapia and other sources of tourist information about attractions in destination, and communication possibility. The architecture of Geo2Tag platform allows uploading information about tourist attractions from any kind of geographical information sources to own instance of platform and extending this information with additional tags with geographical marks (geotags) from sources like local tourist centers, museums, or local volunteers and tourists.

Rest of the paper is structured as follows. Section 2 contains brief review of volunteered geographic information services specifics and works related to VGI. Section 3 describes features of Wikimapia that are related to reasons for including it to the TAIS. To operate over Wikimapia data it is proposed to use the Geo2Tag platform. Features and benefits of the platform in comparison to the similar services are described in section 4. The proposed scenario of smart tourism destination support and example of scenario work is described in section 5.

II. VOLUNTEERED GEOGRAPHICAL INFORMATION

The evolution of Internet from personal static websites to dynamic interactive services makes possible involving great number of people in content generation and collaborative task solving. One of the great task that is solving now by collaboration of large-scale web-community — is a creation of world map. Most of people have no specific skills and knowledge and could not be estimated as specialists in geographic information science, but in collaboration, they have profound impact on geographic information systems. This phenomenon has been termed as volunteered geographic information [12].

The discussion about phenomenon of volunteered geographical information as a special case of user-generated content is early appeared in geographic information science in 2007 [12]. The most asked questions through all the discussion about geographic information and VGI in particular was about quality of information: its accuracy completeness and reflection of the actual geographic information, and what sources of information is better — proprietary, or volunteers.

To find answer on these questions, researchers analyze two main VGI projects that operate with worldwide content: OpenStreetMap and Wikimapia. Both projects have started more than 10 years ago (OpenStreetMap starts at 2004 and Wikimapia – at 2006). Both have grown from conceptual ideas to most successful examples of VGI with more than 3 million contributors in OSM (Fig. 1) and 2.5 million contributors in Wikimapia (Fig. 2). However, in spite of they have similar conceptual goal to create most complete map of the world, their real goals and approaches to reach them are completely different. OSM is aimed to create database with information about points on the Earth surface. OSM database contains more

than 3.5 billion nodes, 350 million ways, and 2.5 million relations between nodes by now. These items are used to create map of selected area and to provide other geo-spatial service. Wikimapia uses a map that is provided by other service (Google) and adds overlay with polygons that enclose objects on the Earth surface and contains description of objects like buildings, lakes, roads, etc. Wikimapia contains more than 25 million places with photos and descriptions.

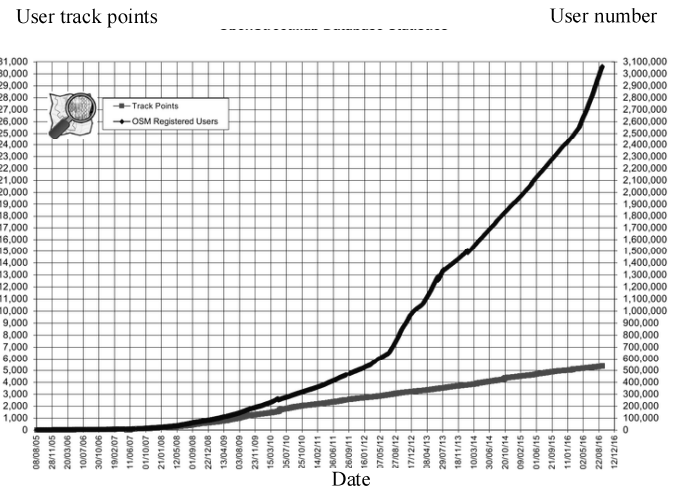


Fig. 1. OSM database statistic (Source: <http://wiki.openstreetmap.org/wiki/Stats>)

The VGI accuracy and completeness are usually compared between any proprietary source and OSM [13]–[15]. This can be explained by OSM approach that allows creating map from the available points and nodes that are similar to proprietary map and suitable for further comparison. Research result for Germany [16], [17], United Kingdom [14] and London in particular [13], France [18], and Tehran [19] shows that difference between proprietary and volunteered data is nor very dissimilar. All researchers also note that the main problem of OSM data is heterogeneity that leads to inconsistency between the OSM and ground-truth data.

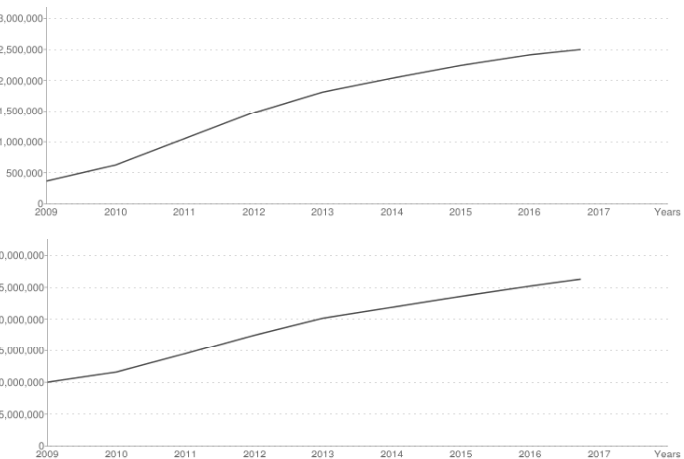


Fig. 2. Wikimapia user (top) and places (bottom) count statistic (Source: Wikimapia)

Researches are also show that VGI quality is strongly depends on the contributor concentration, population density

and socio-economic factors in mapped region and contributor motivation [13], [15]. The list of possible motivation factors could include: unique ethos (altruism), professional or personal interest (contributions as a part of an existing job) intellectual stimulation (learning new technologies), personal investment, social reward (by being a part of a large social network), enhanced personal reputation, self-expression, pride of place (tourism, economic development), relaxation and just fun [15], [20].

Wikimapia project is usually only mentioned in researches as an alternative to OSM. Therefore, it is quite difficult to find extended analysis of Wikimedia data quality. This happens due to the approach used to VGI contribution into each project. Wikimapia could be placed closer to Wikipedia by the type of content. Contributors could not only mark an object with polygon, but also create its description, upload photos, mark categories (tags) the object belongs. In other words, Wikimapia is not a standalone map, but a geospatial overlay for any existing map.

The next section will provide description of VGI impact in tourism domain and comparison of Wikimapia and OpenStreetMap data usage in tourism domain point of view.

III. WIKIMAPIA VS OPENSTREETMAP IN TOURISM DOMAIN

Usage of VGI in tourism domain opens new ways of representation and communication for local tourist systems. Local community of some territory can be not simple venue for organizing activities and services, but become promoters of its territory through the interaction and multimedia interoperability. Community creates tourism image of destination that reflects the nature of new tourism forms. Virtual community or users of the global networks are creators of community feelings. This community has a “cultural mediator” function to unveil values and build tourist images of smart tourism destination. With VGI, it becomes easier to promote a shared vision of local context from any type of user community [6].

To compare the impact of local and virtual communities in creation of destination image the locations of main contributors has been analyzed for the OSM and Wikimapia projects. Unfortunately, the OSM project does not provide information about home locations of members. However there are techniques to estimate a number of local and external contributors based on the changesets analysis [15]. The analysis shows areas with strong local community (high number of senior mappers that has more than 1000 nodes created) has lower number of external mappers in comparison with areas with weak community. This fact can be interpreted as high popularity of the area therefore local communities are usually expanded by visitors, attracted, for example, by tourist points of interest.

In Wikimapia, the information about home location is available only for registered members that fills according field in their profile. Analysis of contributions shows the same tendency as in OSM. Quality of object description, number of available languages, and number of photos depends on local community and the degree of object’s attractiveness to visitors.

The strongest side of Wikimapia relatively to usage in tourist domain is a hierarchical tree of categories [21]. There are more than 6500 categories in the tree. Categories are moderated by contributors with special rights. That allows to provide object classification that is easy to understand and use in information systems. Each objects can be considered to several categories. Due to moderated list of categories, Wikimapia API allows filtering objects by a combination of the categories. The combination can be described with logical equation: “and” relation means that object should satisfy all categories in query, and “or” – at least one category. Table I contains Top-13 Wikimapia categories from upper level of hierarchy used to describe various points of tourist interest. Due to the object can be marked by several categories, column “Items count” shows number of all objects fallen in the category, not only unique for each category.

TABLE I. TOP OF THE WIKIMAPIA CATEGORIES IN TOURISM DOMAIN

Category ID	Category name	Number of items
50	Hotel	301738
51311	Burial monument/structure	274071
1107	Place with historical importance	266613
44605	Interesting place	215439
127	Museum	69387
261	Monument	68035
557	Ruins	65291
2570	Fortification	63242
100	Memorial	37805
478	Sculpture	28191
133	Theatre	23352
55	Tower	21693
53756	Tourist attraction	6002

Object categorization in the OSM is provided by using tags. An OSM object, like a Wikimapia object, can be described by combination of tags. Tags consists of two items, a key, and a value. The key is used to describe topic, category of type. The value details depends on key-specified feature. The sets of keys and values are mostly specified by community, but user can create own keys. By the moment, there are 61259 different keys in OSM database [22]. OSM-wiki recommends marking tourist objects by using tags with key “tourism”. By the moment, there are 1.3 million objects marked with this tag and 1309 values for clarification of object category. Table II contains top-13 tag values by key tourism.

TABLE II. TOP OF THE OPENSTREETMAP TAGS BY KEY “TOURISM”

OSM Tag value	Number of items	Description
information	377 871	Information for tourists and visitors, information centers
hotel	229 049	Hotels
attraction	108 249	Tourist attraction
viewpoint	100 047	Observation platform, place with nice view.
picnic_site	91 660	Place for picnic
camp_site	74 349	Camping place
guest_house	72 443	Guest House and Bed&Breakfast
museum	59 659	Museums
artwork	52 487	Is always used for city art installations
motel	28 912	Housing for short time, especially for car-travelers.
chalet	26 500	A wooden house with overhanging eaves
hostel	25 372	Cheap housing

The following conclusion can be stated based on comparison of statistics presented above. From the one side, OSM provides great number of different tags and values and can provide flexible configuration of object search query. From the other side, Wikimapia provides strong hierarchy of categories and information about greater number of objects with descriptions on different languages, links to Wikipedia pages about these objects, and photos of the location. Therefore, the best option for the tourist assistance service to get access to volunteered geographical information is a union of Wikimapia data as a main information source and OSM data as a map source.

Wikimapia API allows to get most of the information by the REST queries. For accessing the database, the API key is required. API provides functions to get information about place based on place id, area or get nearest places to current location. Unfortunately, the requests number is limited to 100 requests per 5 minutes (or 20 requests per minute) to prevent “denial-of-service” attacks to the main database. The limit can be upgraded by upgrading API key for specified application. To avoid high load on Wikimapia servers the decision has been made to import information to local instance of location-based platform based on Geo2Tag project that is described in the following section.

IV. GEO2TAG PLATFORM

Geo2Tag project has been started as a social network where every message (user’s post, photos, video) is marked with user location information corresponded to content creation time — geotag [11]. Now this is a software platform, which provide base for developing location-based services. Platform operates with *geotags*, which is basic entity containing location information and annotated content (text or media). Geotags are created by *users* – humans or programs. Geotags with common attributes (topic, owner, etc.) can be added to virtual channel. *Channels* are created and managed by users. Platform developers describe three types of channels [11]:

- 1) Public open channel (can be accessed and edited by any user);
- 2) Customized channel (private, channel owner should authorize users to read and create content),
- 3) Broadcast channels (subscribed users can only read content).

The following operations are provided by the platform [23]:

- 1) User-management;
- 2) Data retrieval about users;
- 3) Channel management;
- 4) Data retrieval about geotag, processing and filtration of geotags.

The full list of functions and architecture of the platform, are described in [11]. The main advantages of Geo2Tag platform in case of VGI representing lies in geotags structure, service and channel organization. One instance of platform can contain several services with associated channels. Wikimapia data can be imported in separate service with creating of channels in accordance to categories and appending geotags of two types: descriptions with place locations and photos with

place locations. After the import, platform will start to work as volunteered geographical information platform. Users are allowed to generate new places, edit descriptions and upload photos of the location. In addition, platform allows to organize conversation that is associated with place on the map.

One of the examples of successful Geo2Tag usage is the museum information system “Open Karelia”[24]. The system is aimed to provide access to the expositions of museums in Karelia region from Russia and North Karelia from Finland. Museum exhibit description is accessible through scanning QR-code or by name. Outdoor objects are recommended based on the user’s location and interests.

The “Open Karelia” core is based on the Geo2Tag platform. The core provides function of storing and searching information about objects. Access to the core is available through a service that provides REST-based API. Due to the system architecture, the system is available from any kind of devices: personal computers, smartphones, tablets, touch screen information kiosks in museums, etc.

Object that are museums exhibits and points of interest in region has been added to the “Open Karelia” system by staff of museums in the Republic of Karelia, Russia and museums from the region of North Karelia, Finland during the Euregio Karelia: Museum Hypertext project (ENPI CBC Karelia 2007-2013 framework). The list of museums and objects can be extended by volunteered information from museum staff or active residents of regions. Current database of “Open Karelia” museum information system has been integrated into the tourist assistant — TAIS. Information about the TAIS and steps of integration process are presented in the next section.

V. SCENARIO OF SMART TOURISM DESTINATION SUPPORT BASED ON HUMAN-COMPUTER CLOUD

The proposed scenario (Fig. 3) describes an interaction of computing units in cloud-based system to provide support for tourist in the smart destination. The smart destination is formed by software services and local community members in human-computer cloud. Two general types of actors have to be overviewed in accordance to the human-computer cloud conception used for smart tourism destination support: human- and software-based computing units. Human units present all people resources that are involved in content creation. These units are divided into two categories (Fig. 4):

1) *Contributor* is a content manager that belong to the local community. The content includes geotags, objects, descriptions and photos of objects, reviews about objects, and discussion about visited destinations. Contributors are often volunteers that working with geographical information and create new content, edit and moderate existing content. Tourists also may be contributors while they provide reviews, photos and discussion.

2) *Tourist* is a consumer of smart tourism destination. Tourists send request about destination and receive response with found solutions to help tourist in decision making. Solution can include recommendation about interesting places and objects in the location, extended context information, transportation recommendations, etc. Tourists can leave feedback about destination. In addition, cloud provides

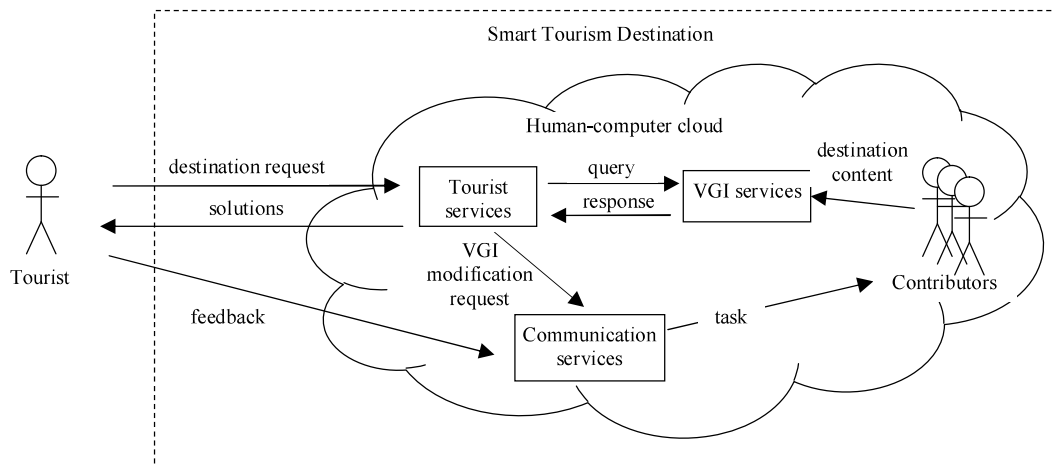


Fig. 3. General scenario of smart tourism destination support based on human-computer cloud

communication platform where tourist may discuss visited or viewed destinations with other tourists or with contributors.

Software units in scenario are presented by cloud services. There are three large groups of services: Tourist service, VGI Service, and Communication service.

Tourist services unite cloud services that are aimed to collect information about tourism destination. There are services for searching of nearby places of interests, information about them, photos, weather, routing, etc. All found information is processed and result is sent to the tourist to help in decision making about destination visiting.

VGI services unite cloud services that are aimed for working with various sources of virtual geographical information. Community of contributors is formed from local destination community that works with geographic information about destination places of interests.

Communication service provides possibilities of communication between tourists and contributors. In addition, it analyzes reviews and requests from tourist services. If there is no information about destination or tourist feedback shows low quality of existing information, the task for contributors is creating. Contributors receive task, and create, modify or moderate information about destination. They can discuss contribution into the VGI platform and create needed changes.

The proposed scenario has been implemented on the base of the TAIS [10]. Tourist assistant – TAIS is a mobile application for cloud-based service, which is related to the category of intelligent tourist guide applications. It recommends the tourist nearby attractions based on tourist preferences and context situation in destination. Various accessible Internet sources are used as TAIS information sources (like Wikipedia, Wikivoyage, Panoramio, WorldWeatherOnline, OpenStreetMap) that provide actual and comprehensive text and multimedia information about different places of interests and user’s context [25].

TAIS architecture is based on usage of cloud services to process information from various sources. The cloud is based on the Smart Space conception. Each service is presented with single Knowledge Processor (KP) and process one and only one source. The results of processing are shared through the Smart Space and then obtained by TAIS client on tourist mobile device [25]. List of available attractions is obtained by recommender service to range attractions based on ratings from other users [26].

To extend functionality of TAIS for the scenario two additional KP’s have been proposed. Both KP are configured to work with Geo2Tag platform that holds services for access to imported VGI from Wikimapia and for geographic-based communication between users. The first KP provides communication with Wikimapia service. Because Wikimapia has limit on the number of requests it is proposed to extend functionality of service by using the “Open Karelia” project that is based on the Geo2Tag platform and contains list of all places of interests in Karelia region. The second KP is proposed for communication between tourists and contributors and is also based on the Geo2Tag project. Several channels are proposed to create for feedback like ratings and reviews in accordance of types of available or requested information in the services of the cloud.

VI. CONCLUSION

The development of tourism sector in combination with cloud computing and Internet-of-Things allows to discuss a concept of smart tourism destination. This concept is described as technological platform that unites ubiquitous and cloud technologies to provide smartness to the destination. Services

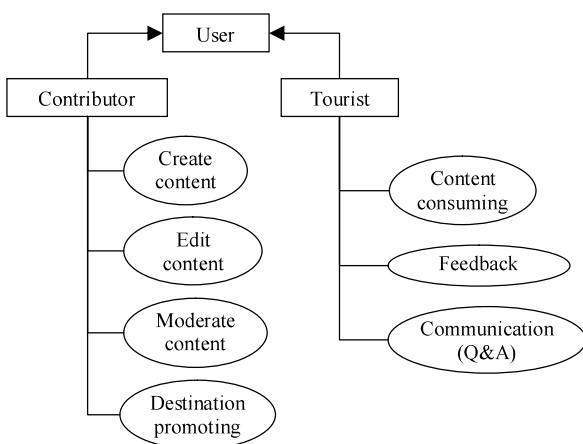


Fig. 4. Use case diagram for scenario users

of smart tourist destinations increase quality of the tourist experience at the destination as well as resident's quality of life.

The scenario, proposed in the paper, contributes to the development of smart tourism destination services. It describes a way to integration of separate computing units in human-computer cloud service that provide support of decision making in tourism destination. Computing units are presented with services that provide search, processing and integration of information available in the cloud, and humans that are contributors and processors of the source information. The proposed scenario allows unite volunteers, local destination community, tourists and information services in smart tourism ecosystem that is goals on creation of tourist content and suitable solutions. The contribution process can be controlled by analyzing feedbacks about existing information.

The scenario has been implemented on the base of the tourist assistant — TAIS. Main services has been reused, such as services for searching of nearby places of interests, information about them, photos, weather, routing. The extension for scenario includes services for access to VGI and communication platform. Both of them are implemented on the base of Geo2Tag platform that provides all required functions for such kind of services.

The future work is focused on the transparent integration of information available in VGI sources with information from VGI service in cloud. Uploading all available information into the service is inefficient due to the great amount of existing data. The second task is focused on creation of user interfaces for uploading a user-generated information (marker, place description, photo, tags, etc.) that will be stored on communication platform, based on the Geo2Tag.

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