Location-Aware and User-Centric Touristic Media

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Abstract. This paper presents an approach that uses geo-temporal media tagging and Web 2.0 ratings to demonstrate the true potential of location-based applications for the tourism and heritage industries. It presents a framework, associated services and a general user workflow, which will allow end-users to automatically retrieve additional information about objects they capture with their GNSS-enabled mobile device, document their route, exchange and acquire geo-based information, connect with peer visitors and receive route recommendations. It provides therefore a new, integrated scenario for accessing on-the-spot information about objects having a cultural value and supporting users on the move to share and retrieve personalised information regarding cultural attractions and routes, all with one click.

Keywords: Geo-temporal coding, location-based services, tourism, media tagging, geo-tagging, content-based image retrieval.

1 Introduction

This paper presents an approach that exploits accurate geo-temporal coding in photos, which will be available in Galileo [1], to develop new ways to retrieve and present location-based media. Its prospect is to transform the use of geo-temporal media tagging and demonstrate the true potential of user-centric location-based applications for the tourism and heritage industries. The proposed scenarios will be used to transform the way current tagging processes are organised, especially how geo-temporal tagged media content is offered and searched for.

The approach presented is based on an open server-side architecture with integrated services and advanced solutions for experiencing, searching, and accessing geo-temporal media content, enabling intuitive presentation and delivery both for professional and non-professional users. Doing this, users move away from today's widely prevalent text search paradigm, towards unobtrusive mixed-media queries and more efficient geo-tagged and user-centric visual content presentation. Through careful consideration and focus on the information interaction needs of users on the move (e.g. travellers, cyclists, mountain bikers, hikers), it enables new user-centric ways of describing and retrieving visual information and significantly enhances travel and leisure activities.

The rest of this paper presents in the next section the state of the art in the areas concerned, the proposed system architecture and the general user workflow as well areas of applications in the field of tourism.

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2 State of the Art

"The increasing power and ubiquity of smart devices such as mobile phones and PDAs means that a visitor to a city now carries with them a device capable of giving location-specific guiding and routing information." [2]

In information technology, developments are rapid and ubiquitous. The availability of global navigation satellite systems (GNSS) such as the global positioning system (GPS) and the emerging European Union's Galileo allows pedestrians to precisely position themselves in an 'absolute' earth reference frame without any knowledge of the body motion, while also providing highly accurate time and velocity, thanks to rapid advances in low cost and low power microelectronics that have produced highly portable miniature user equipment. It is only since a few years that consumers are using GNSS-based devices on a day-to-day basis. The advent of GPS-enabled route planning devices (e.g. TomTom [3], Navigon [4], GoogleMaps [5]), geo-enabled PDA's and cellular phones have instigated a host of new services and devices. The presented approach utilises three basic technologies as a backbone of developments: GNSS-enabled devices, geographical mapping technology, and the forthcoming Galileo satellite information.

Mass-market applications of devices such as GNSS-enabled cameras, navigators, and smartphones, which started with the above mentioned car navigation over the last five years, contributed to the widespread use of GNSS receivers. Multi-modal navigation, local search and social networking are just a few examples of the wide range of emerging applications. The rollout of most accuracy-critical applications, as in e-tourism for instance, has been slowed down by the difficulties of GNSS-based positioning for pedestrians in urban areas. Multipath and masking effects of urban canyons degrade the accuracy of GNSS ranging and increase geometric dilution of precision in receivers that operate in dense urban areas. In the case of GNSS applications designed for vehicles, the effects of these phenomena on accuracy can be reduced, thanks to the velocity of the user that contributes in averaging multipath and the use of map matching. However, pedestrians do not benefit from the same circumstances, and GNSS-based positioning for pedestrians in dense urban areas suffers from inadequate accuracy and integrity. Tests performed in down town urban areas over a variety of mass-market terminals with integrated GNSS receivers show 95 percent circular error probable (CEP) performances between 50 and 100 meters [6]. The presented approach in this paper is motivated by the fact that Galileo will provide more accurate positioning than it is possible nowadays and GNSS receivers have already started to be integrated into mobile phones (e.g. the N95 and E90 mobile devices from Nokia) and digital cameras (e.g. the Ricoh 500SE camera [22]). Manual geo-tagging is possible but not very widespread because it is cumbersome and requires two different devices with synchronised time.

A GPS unit showing basic waypoints and tracking information is typically adopted for outdoor sport and recreational use. Bicycles for example often use GNSS in racing

and touring to allow cyclists to plot their trips in advance and follow the defined course without having to stop frequently to refer to separate maps. Hikers, climbers, and even ordinary pedestrians in urban or rural environments increasingly use GNSS integrated in their smartphones or in stand-alone devices to determine their position. In isolated areas, the ability of GNSS to provide a precise position can greatly enhance the chances of rescue when climbers or hikers are disabled or lost (if they have a means of communication with rescue workers). For specific categories of users with disabilities (e.g. for the visually impaired) dedicated GNSS equipment is also available.

The segment of mobile devices is still growing and new devices are released all the time. Nowadays most of the mobile phones are equipped with digital cameras by default and often they have special abilities like accelerometers, digital compasses, and RFID (Radio Frequency Identification). They offer new ways of interaction with the environment to the user. A report of Harris Interactive [7] showed that 64% of the interviewees, who consisted of young teenagers in the age range of 13-19, use their mobile devices frequently to take pictures. Though it is not only the young people who adopt to work with these technologies, but older users as well. Having a mobile phone of great functional range is still a status symbol. Especially with the release of the iPhone™ and the G1™ the awareness of the greater public for mobile applications increased enormously. They already come with a built-in GPS functionality. Due to the previously named developments the field of location-based applications is of growing interest. Since many people carry around their mobile devices all the time they are interested in using its functionality at each time, wherever they are.

Recently many interesting location-based services and applications have been published and become known to a greater public than before. This year for example Google released an application called Latitude [8] which allows people to access information on where, when and what their friends are doing. Another currently published example is Wikitude [9], which can provide information on prominent locations that are captured with the camera of the G1™.

Beyond the field of fast developing mobile devices the role of the Internet is becoming more and more ubiquitous. The usage of the Internet has become part of everyday life for most of the population, and also the amount of actively contributing users is growing steadily. This is mainly dedicated to the development of the so called Web 2.0, which stands for innovative web applications that allow their users to become an active part of a community and to create their own content. A Web 2.0 platform usually consists of a web space where users can upload, share, and comment on the available content that has been provided by the users. All users generate content and thus turn into producers and consumers (referred also as prosumers), instead of being a pure consumer of the given information. Furthermore, the increasing numbers of so-called mash-ups, even based on simple interfaces, illustrate how content can be produced and processed in a more efficient manner in the future.

In the last few years tagging became increasingly important as well. Usually associated with the above-discussed Web 2.0, tagging describes the process of adding

keywords to content that can be text, images, audio or video. These keywords are used to improve the findability of content in the Internet. The advance of tagging started with social bookmarking services like Delicious [10], that allow users to save all their bookmarks in one place and to classify and sort them with the help of keywords/tags. The current state-of-the-art of accessing, searching, and retrieving multimedia information, requires to manually attaching metadata, keywords, and other information to the content though. This is a highly subjective, non-scalable, and erroneous process. Moreover, while the amount of geo-tagged visual information is increasing, the users on the move do currently lack the appropriate interfaces to have efficient and flexible access to visual data in changing contexts, mobility requirements, edutainment, and travel settings. Such shortcomings can hinder the evolution of location-based applications. In the presented approach we will exploit the more accurate GNSS positioning and combine it with innovative visual features and image header information data to enable more robust object and scene recognition and therefore provide the potential to deliver instant information about cultural objects/scenes captured. This will revolutionise many information push scenarios because it can provide instantly the right information with just on photo-click and demonstrate, therefore, the true potential of the Galileo infrastructure to industry, government and consumers alike.

3 System Architecture and User Workflow

The presented approach builds its developments on an open service-oriented architecture (see Fig. 1) where integrated services and advanced solutions for experiencing, searching, and accessing geo-temporal media content will be implemented. The main aims of the system are to provide:

- A natural interaction with information related to objects, which tourists are capturing with their mobile device or camera, and
- An increased usability of a web platform where users can share, display and retrieve user-centric geo-information with one click.

As seen in Fig. 1, the proposed system consists of several components, which are provided as services and which are connected by the Enterprise Service Bus (ESB). These services contain location- and content-based multimedia analysis, for extracting colour and texture features of the captured images to enable search and retrieval. Other services, take care of the user management, which incorporates individualised storage of user content, as pictures, tracks, descriptions, etc., that are able to be shared with other users. Furthermore the architecture covers presentation interfaces, which build the front-end of the platform. These front-end layers, with which the users interact with the common service of the back-ends, are:

- A mobile client, which will allow end-users to document their route, exchange and acquire geo-based information, just by using their GNSS-enabled device and interfaces to search and retrieve geo-sensitive user-centric media

- A Web 2.0 platform where touristic regions advertising their specific destinations and users visiting those specific locations can share, exchange, search, explore and browse user-generated content. This platform will support pre-travel information gathering and decisions about visiting a specific destination, as well as providing individual users the options to track and present their specific travel routes and sight-seeing tours. During travelling, the platform will act as the back-end for providing information on objects that the user captures with his mobile phone camera. Through this platform it is expected that the adoption of GNSS applications and services will be increased and the transition to Galileo will provide immediately economic and social benefits.

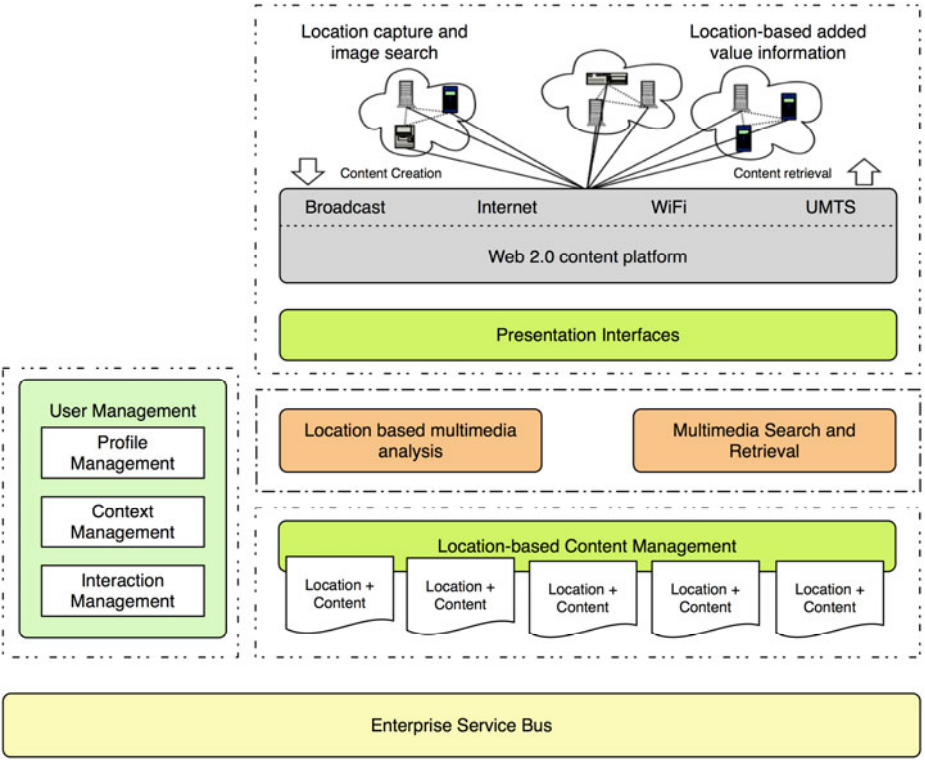

Fig. 1. Proposed system architecture

Since the proposed system is partly envisioned as a Web 2.0 travel platform, it will extensively employ mapping technologies. Both, commercial and open source GEO-API's, will be considered. Non-commercial API's are the ones from OpenStreetMap [11] and OpenRouteService [12]. Commercial API's are developed by the major players in the industry, namely Google (Google Maps [13]), Microsoft (Virtual Earth, including Bing Maps [14]), and Yahoo! (Yahoo! Maps [15]).

Consumers and organisations are more likely to adopt technologies if they can ensure ownership of their own submitted information. Following this observation the proposed scenarios reflect the possibility to tie in personal collections of photographs and thereby generated route information in their personal web presence. Therefore it is also planned to tie in seamlessly with popular content management systems (CMS) or communities (Facebook [16], Hyves [17], LinkedIn [18], etc.). Simple functionality similar to YouTube's methodology [19] could suffice to meet this initial requirement.

In the system development we follow an iterative approach utilising scenarios to portray the experiences that users will be able to have with the proposed (mobile) applications and services. In this context, the word "scenario" is used to mean a narrative description of what the user does and experiences while using a computing/mobile system [20]. To achieve this we will make sure, that the designers understand who their users will be. This understanding is derived partly by studying the user's cognitive, behavioural, anthropometric, and attitudinal characteristics and in part by studying the nature of the work expected to be accomplished. The end user requirements will be gathered through early prototype tests, scenario testing, and the conduction of the yearly Utrecht Observatory of online behaviour. By doing so, the requirements can be refined if necessary during the iterative design cycle. The following user groups are targeted in the project:

- End users: tourists, travellers, hikers; benefitting from the simplicity of organising and exchanging photographs and travel-information in one go just by taking photographs and by receiving instant location-based information on-demand, easy to embed the generated content in personal pages, blogs, and community software
- Professional users: municipalities, tourist boards and offices, natural heritage organisations; benefiting from a platform that can be used for advertising visual route-information/trails, which are a prerequisite for attracting new tourists and hikers and from functionalities to document visually rural landmarks.

For the refinement and development of the project application the usage scenarios will be distinguished in pre-trip, on-the-spot and post-trip travel activities:

- Pre-trip: During the preparation of their trip, the users will have the opportunity to use the project portal. The main aim is to gather information about an area or points of interest (POI), e.g. for developing a sightseeing tour. The portal will provide the users with visualisations of POIs, show recommendations by other users, and suggestions on possible routes and trails.
- On-the-spot: While being at the actual travel location, the use of mobile technology is central to the scenario. The user receives on-spot directions from other trusted users on the platform and can also receive information of captured objects as well document and share routes to his/her community, simply by capturing photographs.
- Post-trip: The main aim is to allow the user to mentally re-visit a trip or parts of a travel by accessing the original photographs placed in the saved route. The portal will improve the way users organise their collection of photographs geographically and time-based.

The general user workflow and processing of the proposed platform is shown in Fig. 2.

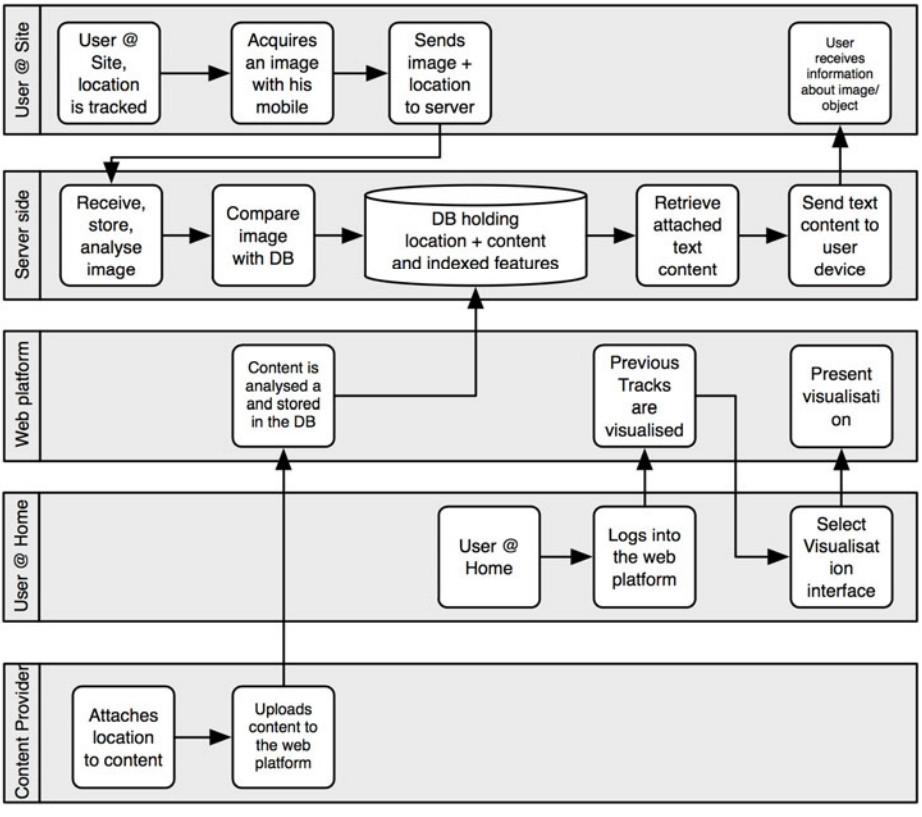

Fig. 2. Typical user interaction with the proposed system and the related processes

4 Conclusions

This paper presents a novel approach to combine location-based image retrieval technology with a web platform and mobile clients for the tourism and heritage sector, the proposed plan to develop the system and the related use cases and scenarios. The open service-oriented architecture, on which the proposed system is based, allows an easy access and improved retrieving methods for multimedia content produced by the users on the move.

By allowing users to contribute to the Web 2.0 platform, a fast-growing community will be initiated to help find and share relevant information, e.g. on a bike trip and stimulate the communication and exchange of experiences with other fellow travellers. Accessing and exchanging information through the platform facilitates the pre-trip, on-the-spot and post-trip activities. During their trip users have the opportunity to immediately contribute to their community and retrieve relevant information.

The iterative design process and the extensive use of scenarios will make it easier to achieve user's expectations. Future work includes elaboration of user requirements on the developed prototypes and further iteration on the system level.

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