SMART GUIDE - THE INTERNET OF CULTURAL THINGS

Andrey Petrov, Plovdiv University "Paisii Hilendarski", rokanor@gmail.com
Alexander Petrov, Plovdiv University "Paisii Hilendarski", apetrovdev@gmail.com
Vanya Ivanova, Plovdiv University "Paisii Hilendarski", vantod@abv.bg

Abstract: The paper presents different approaches of preserving valuable historical data using modern technologies. The IoT paradigm can easily be applied to the field of cultural and historical heritage. Static cultural places can greatly benefit popularity from intelligent objects, sensors, applications and services. Software architecture of an innovative tourist guide is presented.

Keywords: history, culture, tourism, guide, personal assistant, software agents

The cultural heritage of humankind is one of the most important resources upon which travel is based and appeals to many underlying motives for travel [1]. The main purpose of the paper is to focus attention on new technological opportunities for digital representation and virtualization of cultural and historical heritage. Places of historical and cultural importance are revitalized and experience a new surge in popularity among a generation of digitally savvy tourists thanks to several approaches described below.

A large number of museums are offering virtual tours where a person can observe the artifacts in a specific museum and acquire information and knowledge about the place before actually visiting it. For example The Louvre in Paris, National Women's History Museum in Washington, The Oriental Institute Museum in Washington, The Spy Museum in Chicago and National Museum of Natural History in Washington offer a 360-degree interactive tour for online visitors. Another interesting way of representing historical information are the applications PIVOTtheWorld and Living History where users can see experience through their mobile phone a historical monument or place back in time as if they are then and there. Speaking about mobile applications there is a need to mention the various tourists guides specially designed for historical and cultural heritage which can be found on the mobile stores and of course not to forget the most common case where old documents and photos are being digitized.

Nowadays as we hear a lot about Internet of Things we should also consider that cultural and historical places can greatly benefit from sensors, applications and services. The acquired data needs to be analyzed and transformed into a state which can be valuable for common users. With the help of software agents data analysis can be easily achieved.

The authors focus on a software architecture where these things work well together and are combined in a smart tourist guide which is presented to the end user as a mobile application. There are some interesting results from a survey done by V-MUST.NET at the beginning of 2014 with the visitors of the Museum of Fori Imperiali in Rome where more than 100 hundred visitors

replied and the result can be summarised as follow: visitors of this museum state to be familiar with technology (96%), they use audio guides, touchscreen or touch tables(55%) and tablets or smartphones(40%) normally [2].

The main purpose of that application is to properly guide tourists in different Bulgarian geographic regions with historical and cultural value. Online maps, geolocation, virtual reality and personal assistants will be bundled within the application. Museums, galleries, craft shops and others will be stimulated to create custom content and enrich tourist routes within the application. This grants opportunities to promote routes and enhance tourist flows. The dynamically created tourist applications also incorporate a "push model", wherein new tourist content is forwarded to the mobile device with no user intervention as soon as it is added or updated by the administrator [3].

The application will have defined several user roles - administrators, craftsmen, cultural organizations and tourists.

The main target group, which are the tourists, will be able to search for popular tourist routes and to chose to follow one of them while being guided by a personal assistant within the application. The route will be displayed on Google Maps with the time calculated for the tour and the places that they are going to visit. Each place will be available for inspecting through a relevant user interface revealing text information, photos and an option for a virtual tour. When the user is near a specific place, detected by his geolocation, he will be notified by the personal assistant. The role of this assistant is to show visual and textual information, and to play audio information proposed to the tourist in a selection of languages.

Each user can publish his own route which will be available for other tourists using the application. Through a rating system the most popular routes will be promoted in the search results. With the implementation of Facebook, Twitter and Google plus sharing option, users can popularize the smart guide in their circle of friends.

Cultural organizations and craftsmen will be privileged users and their routes will be promoted in search results. In order to qualify for that benefit, they will be required to upload text information, photos and 360-degree interactive tour (which is optional). This strategy will lead to a great data enrichment which is important for the application to have a natural growth of usage with minimal supervision and curation of content.

Administrators of the project will be responsible for bootstrapping the experience by creating the first sightseeings, monuments, museums, galleries and craft shops listed within the smart guide.
In case of need other user groups can be created such as municipalities, medias etc.

The places within the tourist guide will be divided in different categories: cultural, historical, monuments, museums, craft shops. A place can belong to multiple categories. Search functionality will be divided into two main parts. Searching for a tour or searching for a place to visit. Searching for a tour will be done via criterias such as time range, while searching specific places can be done within a predefined radius. Each will have the option to start the search engine from the current geolocation of the user and will include filtering by location category.

The authors plan to develop the application for the two most used mobile platforms Android and iOS which combined cover more than 90% of Bulgarian mobile phone market and allow for a widespread adoption.

The architecture designed by the authors is divided into the following layers (*Figure 1)*: Database, Web Service, Content Delivery Network (CDN) and two client applications - mobile client for tourists and web client for users who will be able to administrate the data.

1. Database layer
   Stores data of cultural objects, tourist routes, ontologies and user preferences.
2. Web Service Layer

Contains the core business logic of the application in four main modules - Admin, Personal Assistant, Google Maps Data Formatter, Push Notifications Manager.

- Admin

Provides API for admin web client. Its main purpose is to provide mechanisms for data and metadata upload and administration. This module is responsible for curating data displayed on the mobile client and for enforcing the observation of terms of service. Within the admin module there is an integrated promoter manager unit which notifies end users about upcoming events near their geolocation and informs them for newly added cultural places.

- Personal Assistant (server side)

Handles search requests executed by the mobile clients. There is a query analyzer which adds query filters depending on the stored user preferences. There is an ontology manager unit which looks for possible matches based on the ontologies stored. After the query has been executed found results are evaluated depending on the current user geolocation. When the process is completed data is passed to the Google Maps data formatter.

- Google Maps Data Formatter

Prepares data for the mobile client consumer. Combines spatial and domain data into the agreed API format.

- Push Notifications Manager

Responsible for sending events created by the admin module to client apps via Google Cloud Messaging and Apple Push Notifications Server.

3. Mobile client - Contains the user interface of the application in three main modules Data Visualiser, Personal Assistant and Api Communicator.
   - Data Visualiser

Acts as a controller responsible for data rendering of search results and push notifications, visualizations and navigation through the different screens.

- Api Communicator

Initiates the search process.

- Personal Assistant (client side)

Controls data passed to the Data Visualizer and acts as a tourist guide for the user. The assistant also takes care of updating current geolocation and user preferences through the Api Communicator.

4. Web client.

Contains the user interface for administrative tasks performed by super users and admins. Examples include uploading of content, granting and revoking permissions and others.

5. Content Delivery Network

Keeps all uploaded content in a distributed system so that data downloads happen in the quickest way possible from the closest geographically nodes of the network.

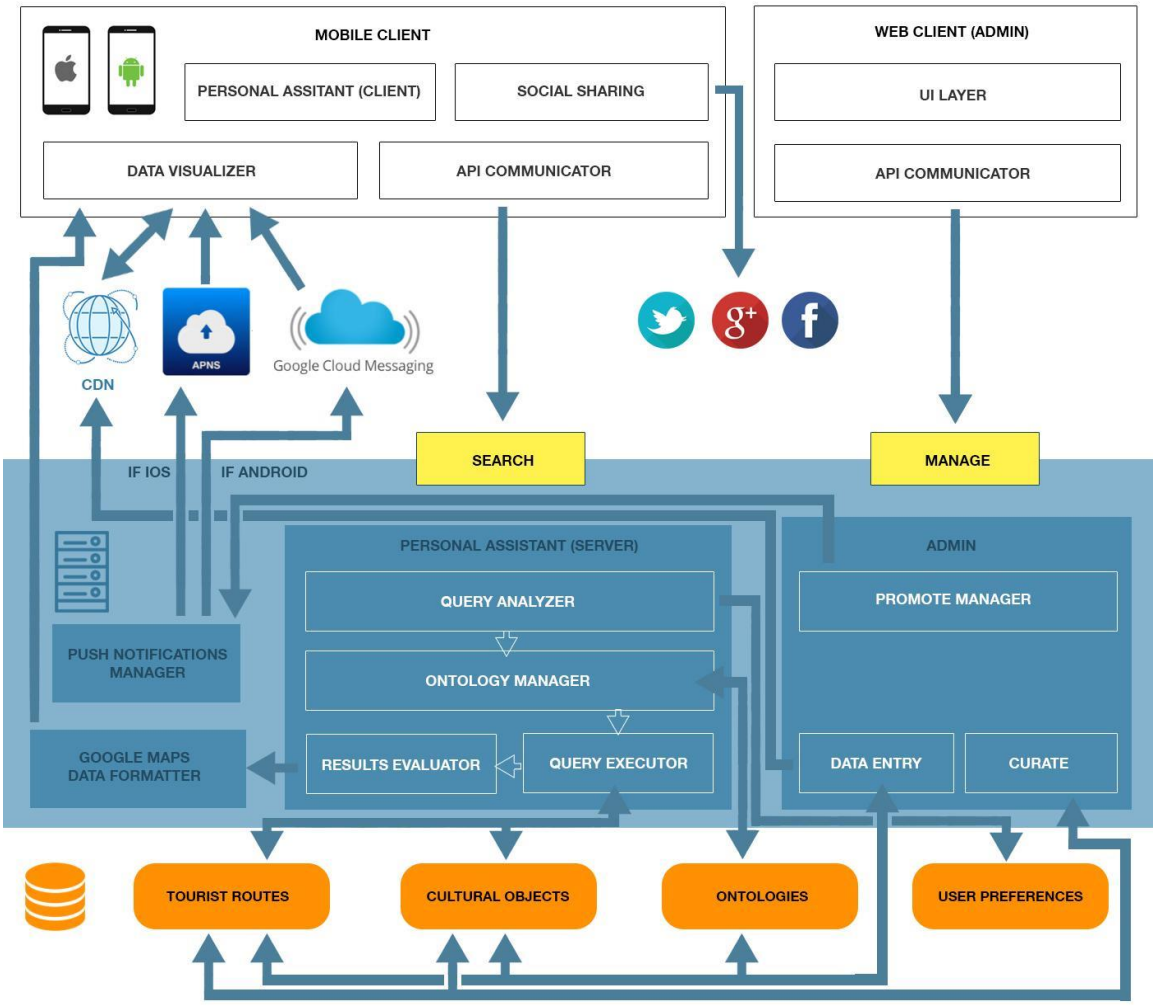

Fig. 1 Smart Guide - architecture

After creating the software architecture and choosing the technology stack the authors have divided the development process into four phases.

Within the first phase the web client will be created where the administrators will be able to enter initial data of cultural objects. Also ontologies will be defined in order to categorize the objects properly.

Second phase will include the server layer implementation and a mobile client prototype which will have minimum functionality such as search of objects and routes, displaying the data found and social sharing.

Third phase will cover push notifications handling and implementing personal assistant on both server and client side.

During the last fourth phase of the project data needed for the initial launch of the application will be uploaded - geolocations of cultural objects, text and audio information, digital photos and virtual tours. After a period of internal testing and bug fixing the mobile application will be uploaded on App Store and Google Play.
The project offers to its authors a rewarding and innovative development experience in which cutting edge full stack web and mobile technology will be fused with personal assistance and augmented reality add-ons.

Hopefully besides its pioneering theoretical value the project will manage to fill in a cultural market niche and boost up the tourist experience of many curios visitors to some of the most noteworthy sightseeings in Bulgaria. Lastly - this work will serve in some ways as a proof of concept and pave the way for other engineers looking to apply agent oriented architecture within the mobile domain.

Acknowledgments
The research is partly supported by the NPD – Plovdiv University under Grant No. FP17-FMI-008 "Innovative software tools and technologies with application in research in mathematics, informatics and pedagogy of education", 2017-18

References

[1] Dallen J. Timothy, Cultural Heritage and Tourism An Introduction, 2011
[2] Sofia Pescarin, Museums and Virtual Museums in Europe: Reaching expectations, SCIentific RESearch and Information Technology, Rome, Italy, Vol 4, Issue 4 (2014), 131-140
[3] Kenteris, M., Gavalas, D., Economou, D. An innovative mobile electronic tourist guide application, Personal and Ubiquitous Computing, February 2009, Volume 13, Issue 2, pp 103–118
[4] Orozova, D., Stoyanov, S. and Popchev, I.. 2013. Virtual Education Space. In International Research Conference Knowledge- traditions, innovations, perspectives. 153-159.