

A tour building and experience sharing web and mobile platform

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Abstract—In the recent years, many tourism-oriented applications have facilitated the life of tourists by providing access to information about Points of Interest (POI) around the globe along with peer-review, recommended routes and tour guides offerings. However, tour guides are mainly using technology that is not tailored to their needs in terms of creation and planning of tours and respective media content. In addition, there are no available technological solutions to share this media with their customers. This document proposes and implements a data model and architecture for an application that serves as a development platform for tour guides to create POI and aggregate them into tours as easily and intuitive as possible, in order to accelerate content development and increase productivity. This system aggregates information from multiple, scalable sources and allows access to the information as a webservice via a RESTful API. There are also two mobile applications proposed and developed with the necessities of tour guides in mind that use the webservices provided by the web application implemented, where one is to be used by tour guides and the other by the tourists. The first's main objective is to download the tours created on the web application and share their media with the visitors, the second, receiving this content. Both applications were developed considering the necessity to be able to work without an Internet connection and following Open Source Software principles.

Index Terms—Tourism, Guides, Media Sharing, Development Platform

I. INTRODUCTION

TOURISM is accepted as one of the world's largest service industries, having experienced continued expansion and diversification, becoming one of the largest and fastest-growing economic sectors in the world [1]. According to the World Tourism Organization (UNWTO), international tourist arrivals grew by 4.4% in 2015 to reach a total of 1,184 million, marking the sixth consecutive year of above-average growth with international arrivals increasing by 4% or more every year since the post-crisis year of 2010, earning 1,522 billion USD [2] in exports. The competitiveness of the market place and the increased expectations of customers have made tourism industry recognize the importance of customer service quality for future revisit and referral business [3], [1], namely tour guides and other front-line staff. Having this importance in mind, providing tour guides with relevant and useful tools is fundamental to a better performance. However, considering the sheer amount of platforms and applications currently developed, tour guides are comparatively very ill-equipped in terms of technological tools at their disposal to provide a better experience to their customers. Technological platforms

focused on tourism are generally focused on the tourists only instead, leaving professionals lagging behind.

A tour is a journey for pleasure in which several different places are visited, and each of those places is considered a Point of Interest (POI). From a technical standpoint, a point of interest is "a location for which information is available". In practice, POI are usually places that serve a public function, thus excluding facilities such as private residences, but including many private facilities that seek to attract the general public such as retail businesses, amusement parks, industrial buildings, Government buildings, and natural features [4]. After personally inquiring tour guide professionals, it became clear that tours are usually planned on notebooks or using spreadsheets and, during tours, sharing media is heavily discouraged. When absolutely necessary, any media shared is done by printing the images into papers and passed along the customers, which leads to a distracting and overall unsatisfactory experience [5]. To solve the planning problem, there are a few services that specialize in POI all over the world, although few of them actually provide an easy way to create custom tours with custom POI and the ones that do, do not provide any interface to externally interact with the data and therefore allowing the reuse of the created content for other applications. To share media, there are no solutions with tour guides needs in mind.

The tourism industry would greatly benefit from a platform that would allow the creation of custom POI and tours, tailored for tour guides, to enhance and facilitate the creation of planned tours through the usage of an application designed with these needs in consideration and a way to share this curated content with their customers in order to provide a technologically-enhanced guided visit [6], preferably without requiring the use of an Internet connection to spare mobile data plans.

A. Proposed Work

This article hereby proposes a platform for the custom creation of POI and tours that can be edited in a collaborative way amongst its users, integrating curated information from external POI providers. Users can create public or private tours and POI, a setting that can be changed at any time, and add curated descriptions and media. An approach to these requirements has been done by Mauro Teixeira [7] but entity structuring, user experience and the desire to develop a platform under Open Source Software motivated a full rewrite of that implementation.

In addition, recurring to a mobile application, the created content must be downloadable to a mobile device so its relevant media can be shared on demand to the tourists, who will be presented with a third application consisting on a web page accessible from any mobile web browser that receives the media being broadcast. This will represent a novel approach for a solution to the current media sharing options available to tour guides and the consequent modernization attempt for this classic method. Figure 1 demonstrates the proposed architecture described.

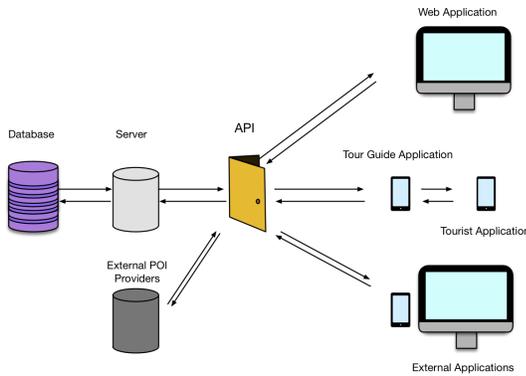


Fig. 1. Proposed platform architecture.

II. BACKGROUND

A. The importance of tourism

Tourism is generally considered as travel for pleasure or business [8]. As a sector, it is composed by the business of attraction, tour guiding, accommodations, tourist entertainment and operating tours [9]. Portugal2020 [10], the result of a partnership between Portugal and the European Commission, describes tourism as a "fundamental activity for its ability to generate wealth and jobs, and for its contribution to the regarding of natural, cultural and patrimonial resources" and, as such, is a topic of great macroeconomic interest, as the Portuguese Tourism sector generated a net value of 8.8 billion euros in 2016 from a gross income of 12.6 billion [11], with a total of 53.5 million overnight stays in 2016 [12], where Lisbon took the ninth rank in metropolitan regions with the highest number of night stays in Europe (total, non-resident) [10].

According to Turismo de Portugal [13], guided tours are the second most desired activity on tourism entertainment and were consequently a focus of several studies to find solutions to make them even more appealing and effective in promoting tourism in Portugal and the return of tourists. One of those studies [14], a survey done to tourists, concluded that 94% of the interviewed were very satisfied with their overall touristic experience in Portugal, but identified infrastructure and touristic information as points of contact with room for improvement. This conclusion proved the SWOT analysis done by Nunes [15] in 2014, that identified a weakness in the low evidence of Innovation and Development applied to tourism and lack of partnerships between the technological and

scientific system and the tourism companies. This analysis also highlighted the rapid change from the destination/geography to the product/experience as deciding factor for tourists as a threat to the sector, a concept already foreshadowed in 1998 by Pine et al. in the book *The experience economy* [16]. The latest strategic plan done by Turismo de Portugal [17], therefore, emphasizes the need of "production and availability of content, development of digital support and technological applications to enhance tourism experiences on Portuguese patrimony and territory". This is interpretable as taking advantage of technology to enrich an experience and make it immersive and interactive [6], an apparently crucial directive for the tour guide professionals who now struggle for a digital platform to enrich the provided experiences.

Looking at the current technological panorama, the usage of smartphone is present in everyday living and greatly impacted routines and habits of the world population [18]. Smartphones and their applications reflect the technical potentials and capabilities of today's tourists [19], a sector with an identified growth potential. Dickinson et al. [20] identified that "Leading visitor attractions and destinations are increasingly adopting smartphone app technology" and as such, not following this trend will likely result in a loss of interest by potential customers in favor of adopting countries. In order to accomplish this task successfully, Brown and Chalmers [21] state that "good tourist technologies are not only those that make tourists more efficient, but that also make tourism more enjoyable" and according to Grün et al. [5], "Providers of mobile tourist guides should especially focus on tourist attractions, events, entertainment and gastronomy, and provide well implemented, customized versions in order to differentiate themselves from others", giving the clear example that "Pushing relevant information to the users can relieve them from the tedious task of looking it up themselves". IPK International [22], a world tourism marketing consultant, concluded that millennials want authentic travel experiences. This "first global generation" seeks authenticity, experience new cultures and are generally happy to provide their personal data to be used in order to create individualized travel experiences, such as through mobile app offering specific personalized access and services. For destinations, this means seamless travel experiences should be offered by using technology to simplify and streamline the enjoyment of experiences.

Although smartphone usage is abundant, it encounters one peculiar pitfall in international tourism, the inconvenience of mobile data plans for Internet usage. This fact forces tourism related applications to consider the offline capabilities with high regard, as free wifi hotspots may be scarce and having solutions fully dependent on Internet connectivity may be unfavored for not taking this point in consideration.

B. Existing Platforms Overview

As a goal to satisfy the needs of tourists, tourism industry and developers looking to tackle this problems, several platforms have been designed. The solutions presented below are all part of the sector in which we wish to work on, even if each of them may present different approaches to slightly

different identified problems. The reviewed mobile and web platforms will not only range from solutions tailored for the tourism industry but also approaches that can be used to fulfill the needs of the sector, even if not their original goal.

- Eurotrip Planner - Eurotrip planner [23] is an online application that allows users to create their tours, composed by predefined POI from Europe, and then export them to a mobile application. It is a side project created by Michael Van der Veen that enables the creation of a detailed tour and the download for a tablet or smartphone where it can be reviewed without the need for an internet connection. The POI presented in the application are premade and cannot be customized by the tourists, only used and aggregated into tours, and the lack of API denies external applications interactions.
- RPoi - RPoi [7] features a well defined data model of POI, groups of POI, external providers and privacy control over the tours (whether they can be made publicly available or private for the owner or group of collaborators with access to the tour) focused on a community driven initiative to aggregate and curate POI related data. It suffers from poor User Interface and the API provided by this platform only supports GET methods, denying any interaction with the web application other than fetch data, making it impossible to create or edit content from external applications.
- Google Tour Builder - Google Tour Builder was originally created to give war veterans a way to record all the places the military service has taken them, and preserving their story and memories as a legacy for their families. It lets users pick locations on the map or search for POI, add notes and media files and building up tours composed of several POI, with a detailed, granular and comprehensive data model for tours. This service provides no API nor clearly defined webservice to reuse the information, making it unfeasible to integrate with third party applications.
- mTrip - mTrip [24] is a mobile application for Android and iOS focused on the travel industry, with several desirable features for travelers and tourism professionals. mTrip serves as a sales point for premade, curated tours that can be bought from the application and will then be available for offline usage, with some customization available, namely custom POI addition and all related information regarding accommodation details and hotel check-in. For tour guides, mTrip offers a business solution that consists of a blank app, customizable with a brand, published under the client company identity and offers booking, planning, satisfaction surveys, messaging and social network integration for post experience enhancement. Pricing of the platform is undisclosed, forcing interested audience to directly contact the sales representatives.

C. Feature Analysis

After the previous overview, it is now possible to compare the provided features of the studied applications and come to

the conclusion that there is little to no software available for tour guide professionals to rely upon to create their customized tours and share them with their audience. In order to be able to share this curated content during the tours, it is desirable to have a mobile application that uses this information and broadcasts it on request by the guide to the customers devices, something not provided by any of the analyzed platforms.

D. Data Sources

To represent POI, tourism-related applications rely on a map interface to visually display the location of the points, even when composed by additional media and content in some platforms. This is based on the nature of a Point of Interest being, in essence, a geographic location and, while the address or even the exact coordinates may not be the most identifiable attributes of the point in question, in a tourism perspective, is one of the most important informations that must be properly perceived by the audience, as it may have a strong relevance for tour scheduling.

Providing a map and serving information about it are two distinct functions, the first is generally done via a tiled map, the second is nominated geocoding, the process of converting a description of a place via coordinates or address into a location on the earth's surface, therefore mapping information into a point on a map tile. A tiled web map is a map displayed by seamlessly joining several image files, called map tiles, into a map display that can usually cover the entire earth surface. Each time the user pans, most of the tiles are still relevant while new tiles are fetched. Geocoding is the process of converting a description of a place via coordinates or address into a location on the earth's surface, therefore mapping information into a point on a map tile.

Both POI providers and Mapping services will be covered below.

E. Mapping Services

Amongst map providers, we will mention the following relevant ones that can be embedded on external applications.

- Google maps - Google maps [25] is a web mapping service developed by Google that provides several map-related services, such as satellite imagery, 360 panoramic views of streets (Google Street View), real-time traffic conditions (Google Traffic) and route planning for traveling by foot, car, bicycle or public transportation. Google maps offers an API that allows maps to be embedded on third party websites and applications. This service is well documented, heavily used across the Internet and relatively easy to implement, but subject to pricing.
- OpenStreetMap - OpenStreetMap [26] is a web mapping service developed by OSM Foundation built by a community of enthusiast and background diverse mappers that contribute and maintain data about roads, trails and POI all around the globe. OSM emphasizes local knowledge, with contributors using aerial imagery, GPS devices and low-tech field maps to ensure that OSM data is as accurate and extensive as possible. It is free to use and Open Source.

F. POI Providers

Amongst POI providers, the following relevant ones were reviewed.

- Foursquare - Foursquare [27] is a technology company that focus on user location intelligence to build meaningful consumer experiences and business solutions. It provides an application called City Guide, a community-reviewed platform for Points of Interest categorized into popular topics, such as nightlife, fun or shopping, for everyday activities. It provides user recommendations and ratings for the venues and gives suggestions based on the search history. Foursquare provides APIs for the venues in its database that can be embedded onto third party applications, providing a solid POI database for population of content, with descriptions, location, user reviews and user uploaded media.
- Direcção Geral do Património Cultural - The DGPC [28] is responsible for the management of the cultural heritage in Portugal, headquartered in Lisbon. It is tasked with the study, investigation and disclosure of all kinds of patrimony and management of architectural and archaeological patrimony in all the country. Amongst all the services it provides, DGPC offers an open data API with information about a vast number of POI in the Portuguese territory on a platform called Informação Geográfica that can be consumed as a RESTful service via WFS, without established quotas.

G. Mobile Development Frameworks

Currently, there are three main methods to develop applications for these platforms; native, web or hybrid development. Native development is targeted for one OS in particular and uses the language available by the platform to develop APPs upon, Java for Android and Objective C or Swift for iOS, and brings out the best performance available to the applications as they are directly tied to the OS and corresponding hardware API functionalities.

Hybrid mobile development is mainly dependent on web programming technologies, as HTML, JavaScript and CSS, with native wrapper code for accessing native APIs like Camera, Contacts, File System, WIFI, etc. Hybrid mobile development tools are gaining popularity in the world due to their characteristic to compile the application source code for multiple supported OSs [29], therefore allowing the same code to be deployed in different platforms, cutting development time and required multiple programming language knowledge, a trend which Phonegap can take credit for.

Phonegap [30] was bootstrapped at the 2008 iPhoneDev-Camp by Nitobi as a way to simplify cross-platform mobile development using standard web technologies. In 2012, Nitobe was acquired by the Apache Software Foundation and Phonegap became part of the open source Apache Project under the name Apache Cordova (name of the street where Nitobi offices are located), helping to reassure that the framework will remain a stable and available tool with community support. This tool's plugins allow a web application to be deployed to

a mobile platform, acting as a wrapper for native OS API calls to the sensors and hardware, as outlined in figure 2.

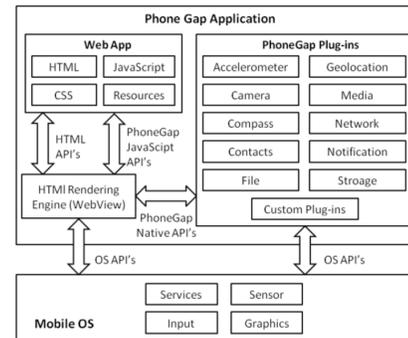


Fig. 2. Complete schema of Phonegap architecture and interfacing amongst components [31].

In order to make the hybrid mobile development a whole-some process, Ionic appeared as an integration solution that relies on Apache Cordova for the OS interactions and builds a mobile compliant UI on top of AngularJS, a UI framework developed by Google. Ionic [32] was developed by Drifty, first released in November 2013 and defined itself as "Cordova with the power of AngularJS". It is a framework packed with a generously large community, good documentation and an overall good development experience.

III. PROPOSED SOLUTION

Mobile technology in tourism still has a lot of untapped potential and as such is focus of several initiatives that try to promote active development of platforms that solve identified problems, a fact highlighted through the previous chapter. Amongst those, there is an identified need for a simple way to create customized tours and POI with a good, intuitive user experience. Also, there is an urgent and ill-explored necessity to have a platform that allows the real time sharing of tour and POI related content with customers as, after the existing platforms review, there was none to be found that could preemptively solve this need in particular.

International tourists make the majority of the tour guide customers [13] and are a good focus group to profile to extract habits and tendencies.

As such, having mobile applications that require the tourist to have an Internet connection is unfavorable and generally undesirable as it requires them to purchase additional data plans abroad. Therefore, tourists must be able to get the content shared by the tour guides without relying on Internet access.

This article proposes a platform composed of a three-part solution to this problem; a web application for creation of customized POI and tours, a mobile application for the tour guide to download tours from the web application and share their media with the tourists, and a mobile application for tourists to receive the broadcast media without resorting to an Internet connection. The users of the platform described in this section are mostly tour guides and tour planners,

either amateurs or professionals of the tourism-industry. They will use the web application to create content, organize tours based on new or existing POI and discover existing published public tours. After that, they will take advantage of the mobile application to download public or owned tours to the device's local storage and broadcast the desired media to the tourist applications. As such, the whole solution must contemplate the required operations in order to fulfill all the aforementioned functionalities.

A. Requirement Analysis

To be able to achieve the proposed solution, several decisions must be made regarding the requirements that will need to be met. First of all, there will be three applications: web application, tour guide mobile application and tourist mobile application.

The web application must be able perform CRUD operations on POI and tours and respective media, possess authentication, access control and well defined APIs. The tour guide application should be available for Android and iOS, be able to download created tours and use the device local storage to save content and access the networking hardware configuration. The tourist mobile application will be a platform independent mobile tailored web application that receives content from the tour guide application.

B. Platform Architecture

In order to fulfill the functional requirements, a platform architecture must be defined. The platform architecture shall consist in a web server with RESTful APIs that handle the application logic and serve a well defined interface for external application interaction, a Database system to store all the entities and data, a frontend component to run on the web application client-side to serve as a pleasant and intuitive gateway to the underline application logic, the tour guide mobile application connecting to the webserver via the defined APIs and the mobile web application for the tourists directly connect to the tour guide mobile application. Figure 3 shows the base architecture that supports the tailored data model and established functional requirements.

IV. IMPLEMENTATION

it now is necessary to choose the technologies that are going to be implemented in order to make the end product and provide information about additional networking based configurations required to the proper functionality of all components.

A. Chosen Technologies

The whole web application, as defined in the platform architecture, is composed by a frontend solution, a backend solution, a database management system and map and external POI providers. AngularJS was adopted for this project's frontend component due to its popularity and consequent rich documentation and community support and object oriented programming. To help with the layout styling, Bootstrap was chosen as it is a well established library for high level

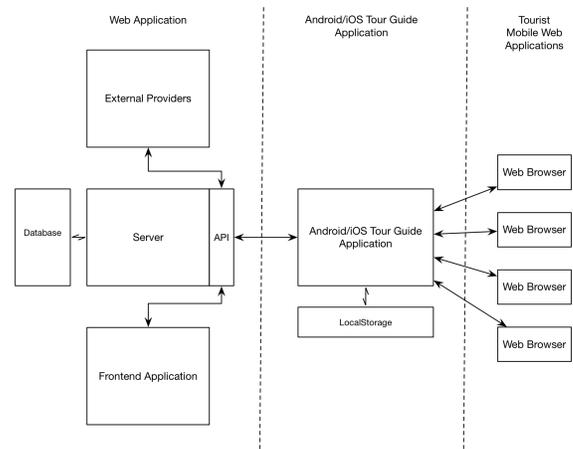


Fig. 3. Base platform architecture.

layout components that provides support for dynamic sizing of elements based on the client screen size (a page presented in a desktop will be different than the same page presented from a mobile device), which is a necessary feature to properly present a web application across as many screen resolutions and devices as possible. For the backend, NodeJS was chosen for outperforming all competition [33], [34] and being JavaScript. As a database management system, MongoDB was picked over SQLesque solutions for the easy integration with NodeJS and the outperforming speed and scalability. Both the POI providers mentioned were implemented and OpenStreetMaps was chosen as the map technology.

For the tour guide mobile application, all development was done embracing the hybrid solution provided by Ionic to cut down development time and be able to deploy to iOS and Android with the same codebase.

The tourist application was developed as a simple mobile web page.

B. Implemented Architecture

The implemented platform is equipped with the following basic operations provided

- 1) CRUD operations on POI - User can create, view, update and delete POI, although update and delete only if authorized;
- 2) CRUD operations on Tours - User can create, view, update and delete tours, although update and delete only if authorized;
- 3) CRUD operations on Tour and POI Media - User can create, view, update and delete media. Adding media can be done by either uploading or referencing via URL;
- 4) Add POI to collection - User can add POI from public or accessible tours to his personal POI collection, by creating a copy of it;
- 5) Add user to access list - User can add other users to have access to his tours;

Figure 4 demonstrates the implemented web application with all the technology choices considered. The next subsections will cover each application specifications with more detail.

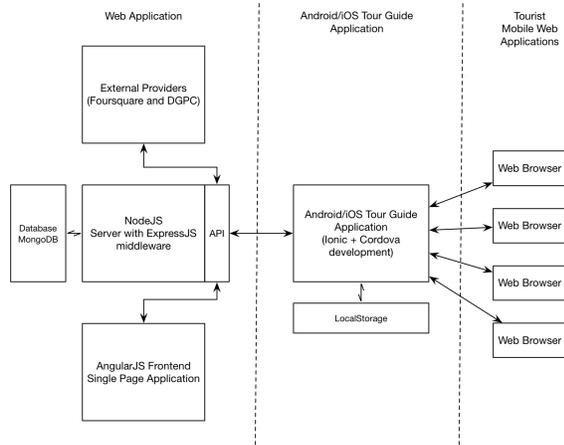


Fig. 4. Detailed implementation architecture.

C. Web application

The web application implementation choices gave order to the following specifications:

- 1) Clients use a compatible web browser to access the web application (Google Chrome, Mozilla Firefox, Safari, Opera, Microsoft Edge);
- 2) The web server serves the Single Page Application to the client and provides the webservices API routes in parallel;
- 3) The API routes are used whenever any request to handle database data is made, either internal or external;
- 4) The SPA has routes, views, controllers and services to act as an interface between the client and the server;

D. Tour Guide Mobile Application

The tour guide mobile application has the following core features:

- 1) Tour Guides Log in the Application to authenticate themselves with the web application;
- 2) After authenticated, they can browse their collection of tours and download them to local storage;
- 3) Having downloaded tours, they can use the application without internet connection and start broadcasting to other devices;
- 4) As soon as broadcasting is enabled, network configuration will be prompted to the user to turn on the mobile hotspot, wifi or mobile data, pointing the generated IP address for the broadcasting server to be supplied to the tourists. At this moment, the tour guide application is effectively serving as a dedicated web server accessible via LAN or internet;
- 5) While browsing the tours and while broadcasting is enabled, media can be selectively picked to be shared and, if so, is broadcast to all listening devices.

E. Tourist Mobile Application

Assuming the installation of a web browser as an implemented architecture, the specifications for usage are as the following:

- 1) Turn on the device's wifi and connect to the tour guide created hotspot;
- 2) Open web browser and point to the IP provided by the tour guide;
- 3) Tourist is now actively listening for new media to be shared by the tour guide.

V. FUNCTIONAL EVALUATION

This section presents the interfaces of the platform developed and demonstrate how they adhere with the previously established requirements. Continuing with the structured separation of concern, the web, tour guide and tourist applications are split into three different subsections that will properly delve into the topics.

The coverage of the functionalities may not follow the same order as presented in the chapter four in favor of the order in which they are executed by a user, enabling a more fluid sequence of events.

A. Web Application Functional Evaluation

The web application was deployed into a server at INESC-ID and is currently accessible from any browser at <http://146.193.41.162/fidel>, provided the existence of an Internet connection. Greeted with a quick explanation of the application's functionalities in the home page, the visitor can now proceed to browse existing public tours or authenticate himself.

1) *Authentication:* A Login button is accessible at all times from the navigation bar at the top to an unauthenticated user, that will guide him/her to the authentication forms. When clicked, the login form is presented containing a link to the register form in case of a first time user. After either logging in or registering, the user is authenticated into the application and the login button is traded for the user's full name and additional, now revealed, functionalities.

2) *Tour creation:* In the tour creation form, a user will be presented with placeholder text on the boxes indicating the purpose of each field, title and description respectively. Filling and submitting will lead to the creation of the input tour.

After submitting, the user will be redirected to the newly created tour and all its content, still minimal for now, and a range of possible interactions with the tour content. At this point, adding tour media, new POI to the tour, edit its content or adding another user of FIDEL as a collaborator are presented as options.

3) *POI creation:* In the POI creation form, a user can either choose an already existing POI from his/her collection or create a new one. When inserting the required information, a location on the map can be achieved from searching by given name or address, clicking on the respective magnifier. Although not presented to the user, the system is keeping track of the coordinate pair of the searched locations and save this information when submitted. After this step, a search in the vicinity is available to locate related POI in the surrounding map area from either Foursquare, DGPC Protected Patrimony (PP) or DGPC Non-Protected Patrimony (PNP). Then, favorable matches can be linked with the POI being created, a process finalized when clicking the submit button.

4) *Media addition*: The process of adding media to a tour or to a POI is essentially the same, but from different starting points. As tours have a set of options, POI too have an *Add Media* option. When clicked, the user will be presented with a modal that accepts drag and drop upload of media, simple media browse upload or external URL reference. In the last case, a title for the referenced media is required, in all other cases, the uploaded media's name will be the same as the original filename.

5) *Tour, POI and Media editing*: To edit media, simply click the target image from the tour or POI screen and the *edit* button under options will lead to the same functionality.

6) *Tour permissions and POI reusability*: When a user creates tours or POI, they are automatically added to his/her tour collection (*My Tours*) and POI collection (*POI Collection*). The tour collection aggregates the tours that will be accessible from the mobile application and helps tour guides keep track of their created content. POI in the POI collection will be "owned" by the user and can be reused in other tours, either existing or new. The POI in this collection will also link to a slightly different view that is complemented with the information of which tours that POI is currently enrolled in addition to all the previously presented information.

7) *API webservice*: All the aforementioned operations were achieved by consuming the webservices provided by the backend, which is accessible to external applications, namely the tour guide application. A full list of all the methods, input and output parameters will be available under <http://146.193.41.162/fidel/api/documentation>.

B. Tour Guide Mobile Application Functional Evaluation

The experimental tour guide mobile application developed, not available on the Google App Store, is downloadable from the FIDEL home page. The main focus of this application was making sure it met the functional requirements provided. Consequently, the presentation layer that will be demonstrated still has some tweaking ahead to make up for a pleasant user experience.

After downloading, installing and starting the application, the user will be presented with four tabs:

1) Homepage tab;

This tab presents the user with a greeting message, serving as a landing page.

2) Settings Tab;

From this section, the user can enable the broadcasting service that translates in starting the web server functionality of this application. Toggling it on will provide a popup message stating the IP address from which the service is reachable, to be provided to the tourists. To be reachable, the tour guide must either enable the hotspot functionality of Android/iOS operating system, connect to a LAN switch or the Internet.

3) Online Tours Tab;

When navigating to this tab, the user will be prompted to login to the FIDEL platform if not already authenticated, requiring internet connection. When authenticated, the user will be presented with his/her created tours from the website, browsable and downloadable.

4) Offline Tours Tab.

In this tab, the user will have access to all downloaded tours and all media associated with them and their corresponding POI that can be shared on demand after starting the broadcast service. In addition, tours can be deleted from the local storage.

These four tabs fulfill all the required functionalities proposed in chapter three.

C. Tourist Mobile Application Functional Evaluation

When the broadcast service is started by the previously mentioned solution, the tour guide is presented with the IP address of the server and share it with its audience. A tourist connects his/her device to the hotspot created by the tour guide or, if any of the other cases, Local Area Network or Internet, and navigates to the given IP address to be instantly provided with a web application designed to receive media from the *share* functionality of the tour guide application. Effectively, the tourist device is now actively polling the mobile web server for updated content and fetches it when available.

No further interaction is required at this point, even though the tourist can zoom in, inspect the received media and save it to the device like from any other Internet page.

VI. MOBILE APPLICATION POWER CONSUMPTION

When in a tour, either indoors or outdoors, the tour guide and the tourists are usually moving around different places. For a tour guide, the battery life of his/her device should be enough to cover the whole duration of the tour, at least, using the application developed. Therefore, studying the power consumption of the application in different use cases is important to estimate how long can it be used without having to recharge the device.

To run the tests, it was used a Xiaomi Redmi Note 2 with Android 5.0.2, 2GB RAM, Mediatek MT6795 Helio X10 Octa-core 2.0 GHz Cortex-A53 CPU and a Removable Li-Po 3060 mAh battery.

This experience was done with the help of Trepp Profiler [35], an on-target power and performance profiling application for mobile applications developed by Qualcomm and positively reviewed by Pandikumar and Sumathi [36], who highlighted its capabilities to measure energy consumption from designated applications. All considered tests were run for approximately ten minutes each, with screen luminosity at a minimum, and all other applications and services disabled. Their results were validated through inspection of the output graphical data, that confirmed a steady average power consumption even if the run time was higher.

The test cases to evaluate power consumption and compare it to other applications presented in figure 5 were designed as following following:

- 1) Tour Guide Application with wifi turned on and no clients (no tourist applications);
- 2) Tour Guide Application with hotspot functionality turned on and no clients;
- 3) Tour Guide Application with wifi turned on and one client;

- 4) Tour Guide Application with hotspot functionality turned on and one client;
- 5) Tour Guide Application with wifi turned on and five clients;
- 6) Tour Guide Application with hotspot functionality turned on and five clients;
- 7) Google Chrome with wifi turned on;
- 8) Hearthstone, a popular mobile game developed by Blizzard, with wifi turned on.

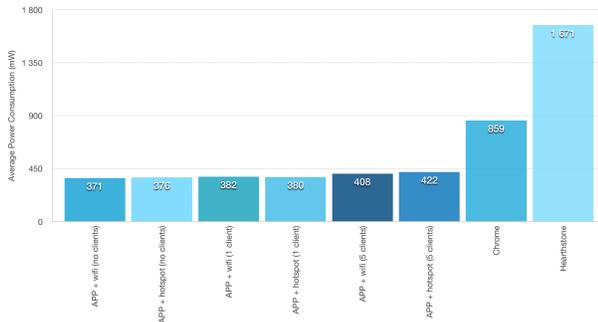


Fig. 5. Application Data Model.

The test results concluded that using the tour guide application consumes roughly the same in either scenario, and that consumption is much lower than Chrome and, especially Hearthstone, the mobile game that was introduced in the test for scaling purposes as it is a heavily taxing application. The values experimentally obtained prove that intensive usage of the tour guide application will not be a significant problem for the battery lifetime. Different devices are bound to have different battery autonomies, therefore this data only serves as an informed indicator.

VII. CONCLUSIONS

This document started with the description of the current state of tourism, the tourism industry and its relevance and the issues felt by tour guides and their customers. The goal of this article was to produce a data model and a system architecture that supports the development of a platform that would address ill-resolved issues and properly implement it. In order to fulfill this mission, research has been made regarding existing applications and services, gathering the requirements needed to be met. Based on this step, a data model was defined that would serve the intended purpose and a generic and flexible architecture was presented that would serve as a platform for the creation of custom, curated tours and POI, with support for sharing media content on demand with a mobile application without requiring Internet connectivity. The platform was then developed and met the requirements analysis defined, resulting in a robust web application and a lightweight mobile application.

This work takes novel approach into solving a necessity in the delivery of technologically-enhanced experiences by tour guides to provide the best possible experiences to their customers.

A. Achievements

The project developed provides a centralized platform for creation of tours and POI, with aggregation tools from external providers and delivering this content to third party applications via webservices which was urgently needed by tour guides and developers for tourism applications. The mobile applications created as a result of having this service not only demonstrate its power, but also implement the major feature of sharing content without requiring an Internet connection, a novel approach to technologically enhance walking tours experience. In addition to all the functionalities provided, the greatest achievement of this ambitious work is setting the foundation for a lot of derivative products and modular extensibility to either the web application and the mobile applications developed.

B. Future Work

This project sets a base for numerous possible extensions. As such, these are the ones chosen after careful consideration:

- 1) Improve the interactivity between the tour guide application and the tourist application;
The functionalities provided by the mobile applications fulfill the established requirements. That being said, they have an enormous potential to be further developed, such as peer-to-peer streaming, audio guide for tourists or itinerary tracker.
- 2) Integration with other related platforms;
These applications, although focused with tour guides necessities in mind, are easily expandable to related sectors, such as museum expositions. As such, and considering the work developed by Marta Lima [37], an integration of both platforms would achieve a quality proposition for both platforms.
- 3) Designing a business plan;
This work was developed with few regards to monetization for academic purposes and as an open software mentality. It was only considered a tiered offer mentioned in chapter four (personal, community or enterprise). However, to be economically viable, it needs a well defined business plan that can make it a sustainable platform, a concern left for future consideration.
- 4) Adopt the media sharing technology to different sectors;
This work was based upon tour guides necessities as the top priority, but the technology developed has a far reaching potential that is not limited to that sector. Therefore, the features provided by the mobile applications can be applied in different scenarios, such as presentations and lectures.

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