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# Tourist Recommendation Systems: Solving Mobility in a Private Vehicle With Support for Parking

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## ABSTRACT

A tourist who visits a city in a very short time needs to visit the most important Points of Interest (POIs) they can be identified by relating them to the interests of the user, or they can choose the best POIs according to a specific requirement. Additionally, when the tourist arrives in a city or place given the distance from one POI to another, they could decide in real time to visit the city on foot or by private vehicle, among other alternatives; then, when they arrive at a certain POI, they need to identify parking spaces where they can leave the vehicle as long as there are parking spaces available and the cost of leaving the vehicle in that parking lot is known. To solve this problem, in this document, an application is presented, a tourist recommendation system that infers in real time the tourist's interests by analyzing feelings about phrases inherent to images of tourist interest from the Facebook social network. With this information, the best POIs to visit are identified. In a complementary way, the tourist is shown the option to choose the POIs most visited by other tourists. To improve the proposal, the Tourist Recommendation System (TRS) offers the user two possibilities to generate the routes, they can choose to visit the chosen POIs on foot or by private vehicle; this change can be done in real time. Furthermore, when the tourist makes a stop during their visit, they can search for nearby parking lots, and from the chosen parking lot they can verify whether or not there is space available and the cost of said parking lot. With this contribution, tourists will have a TRS, which, in addition to identifying their interests, to choose the best POIs to visit from a list presented. And additionally, it solves the parking search problem, making the tourist reduce time when parking their vehicle.

**Keywords:** Tourist recommendation system, Parking problem, Vehicle mobility, Identification of tourist interests

## INTRODUCTION

At present, tourists have all the facilities to travel. Metropolitan cities are generally desired destinations for many of them. In general, these cities have all the services required by tourists, such as hotels, transport services and various attractive points of interest (POI) for tourists. However, one difficulty that these large cities usually have is the lack of parking spaces, because many times these are full, but it could also happen that their parking prices are too

high. Tourists usually have three means of getting around a city: on foot, by private vehicle and through the metropolitan transit network. But, when a user uses a private vehicle, they are left with the question of whether it will be easy to find parking spaces and how to get to each one of them in the city, which is unknown to tourists. It may happen that the parking lot identifies, but when they arrive there are no spaces available, this problem involves wasted time and resources. Therefore, if the tourist decides to move in a private vehicle, it is necessary to easily identify parking spaces and in advance to know if there is space to leave the vehicle and the cost of parking the vehicle. The other mobility options through the metropolitan transit system are not covered in this document.

To solve this problem, a tourist recommendation system (TRS) will be presented, which will include a preliminary study of the interests of that user from comments and reactions on tourist images published on the Facebook social network, which will be subjected to sentiments analysis, to characterize the profile of tourist interests. In addition, the user will be able to find parking lots, and will have information about them: they will find out if the parking lot is open at the required hours, if there is space available, its cost and the routes to get to each one of them. The solution to this problem is of public interest and we differ from the other researchers in that we include the option of identifying empty parking spaces and the cost of that parking lot. In addition, this information is presented in real time.

To carry out the interest identification process, a natural language classifier server called AUTOML from Google Platform was used, through supervised learning in which algorithms use labeled data to predict the category of a phrase. On the other hand, the TRS is a mobile application that with the user's permission activates the GPS to identify where the user is and accesses the social network Facebook to infer interests from the texts, reactions on images of tourist value. By applying a 2D map, the routes on foot or by vehicle are presented, and the user can search for parking lots for which their information and parking availability are presented.

The rest of the article is organized as follows: in the Related Works section, related research is presented to justify the importance of this proposal. The proposed method presents the development of the TRS. Next, Analysis of results are exposed; and finally, Conclusions are presented.

## RELATED WORKS

In previous works, (Tenemaza, Luján-Mora, et al. 2020), throughout this research, we present algorithms applying different technologies to solve the characterization of the interest profile of the tourist. In this document we add a new option to infer interests. In addition, we propose a modification to the genetic algorithm to optimize itineraries for several days of visiting a city. In questionnaires answered by tourists, the need to present parking services with relevant information for the user or tourist was obtained.

We have observed some relevant authors in TRS. In the (Gavalas and Kenteris 2011; Souffriau et al. 2008) they TRS addresses tourism personalization by allowing the selection of tourism content, and offers personalized

recommendations considering the user's location, current time, weather conditions and the user's mobility history, and allow users to assess POIs without activating GPS, through a system of wireless sensors. This proposal offers a solution for walking tours, despite being a robust TRS, it does not consider vehicle tours and fewer parking search systems.

In addition, in (Gavalas et al. 2014; Ricci 2010), coincide in the analysis and present a study of services that must be offered by the TRS to the user. The services identified are restaurants, hotels, transportation services, information offices depending on the season of the year, and other options that make the TRS interesting. In addition, they mention modes of transportation such as walking, cycling, bus, tram, subway. In the same way it is observed that the solution does not go by the identification of parking lots.

On the other hand, in (Klotz et al. 2017) analyzes aspects for drivers based on services available on the web, such as views, points of interest and activities, the purpose is to recommend places and activities considering the driving context. They propose accommodation, vehicle amenities, events, gastronomy, and points of interest. And we once again observe that analysis of parking in metropolitan cities is not included.

The proposal of this work has value, in the sense that the user will have an important service since the informed search for parking spaces solves a problem that tourists face in metropolitan cities.

## PROPOSED METHOD

In this section the method of our TRS is proposed: a) Preparation of the Natural Language Classifier AUTOML server of Google Cloud Platform b) Inference of tourist interests analyzing reactions on tourist photos from the social network Facebook, it is included in Sentiment Analyzer Server to verify if the comment associated with a photograph is positive, in order to verify if the place exposed in the photograph is of tourist value, c) Identification and presentation of parking lots according to the context of the user's vehicle; in addition to the routes to reach any of them; all this information is presented on a 2D map. Figure 1 shows the architecture used to implement the proposed method.

### Natural Language Classifier Server Preparation

Figure 1, the architecture in the Model Unit shows the preparation and training of a Natural Language Classifier AUTOML server from Google Cloud Platform, to obtain a model capable of predicting the type of POI corresponding to a phrase. To train the server, phrases mostly used by tourist groups were collected from Facebook social network; each phrase requires a label that identifies it. For investigative purposes, the search for phrases focused on parks, museums, churches, and restaurants; 80% of phrases were used for training and the remaining 20% collected were used to test the server. Table 1 shows phrases classified expressed by tourist groups and classified by AUTOML.

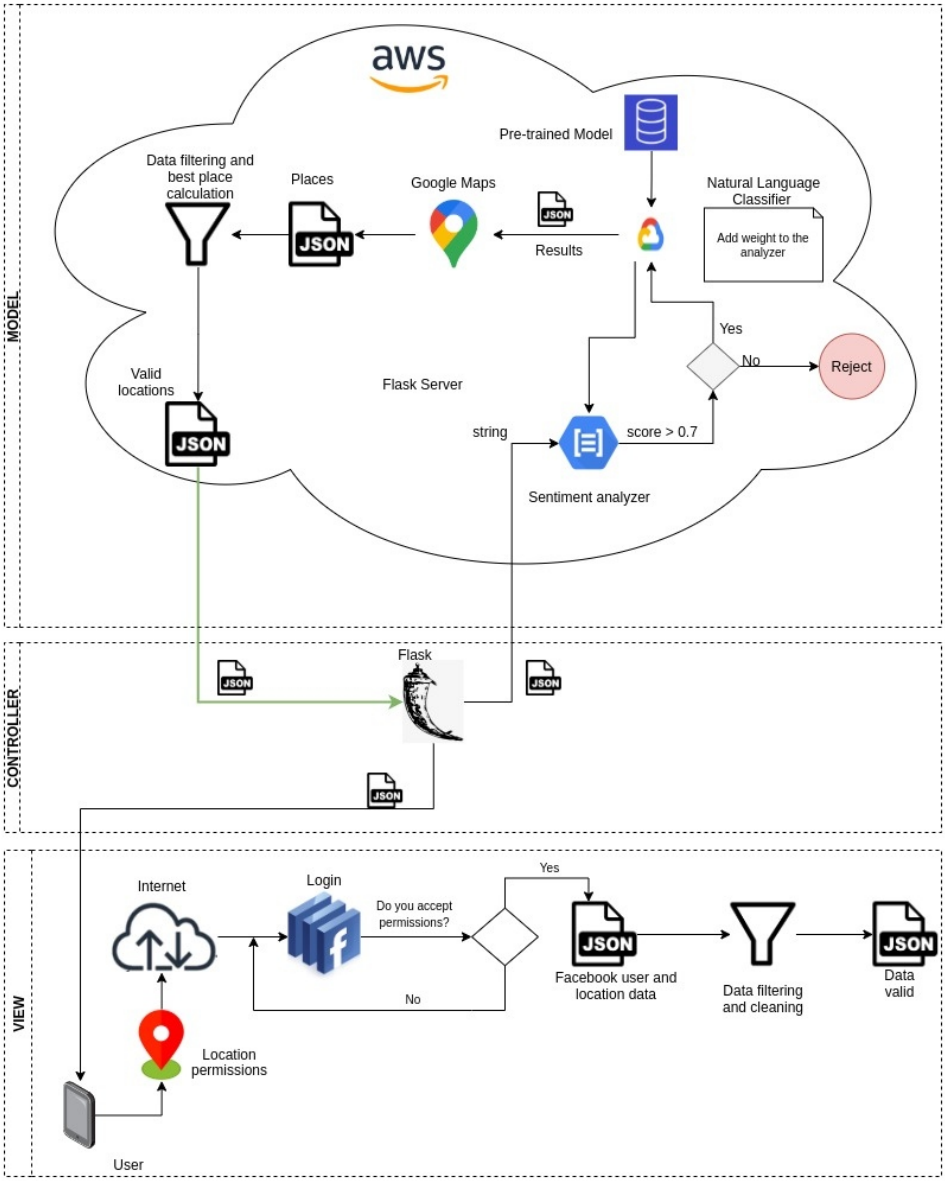


**Figure 1:** Architecture system.

**Table 1.** Example of phrases classification.

| Phrases | Types |
|---|---|
| The mountain inspires me freedom | Park |
| Excellent weather to have a good time | Tourist-attraction |
| The best beach, enjoying it | Tourist-attraction |
| Very good food | Restaurant |
| Admiring the works of the actor | Museum |

## Inference of Tourist Interests Analyzing Reactions on Tourist Photos From the Social Network Facebook

The next step is to identify tourist interests. Figure 1 in the unit "Vista "an application is created, through an interface which asks the user for authorization to activate the device's GPS and to access its data on the Facebook social network. If the user authorizes, they bring his personal information, such as name, photo, email and his last 25 publications from the Facebook social network that have to do with tourism. If the user does not authorize, it is presented with the best POIs evaluated by other tourists.

In Figure 1, the "Model" shows a sentiment analyzer server; sentences with a score greater than or equal to 0.7 are considered, that is, those that are clearly positive.

Equation 1 shows the formula applied to express the interest in percentage value on each type of POI, the sum of all the prediction scores is them adequately divided by the number of times that the type of POI was identified, multiplied by 100. Table 2 shows the results of this process.

$$\text{interestPOI}_i = \frac{\sum_{i=1}^{n} (\text{score}_i)}{n} * 100$$

Equation 1: Interest for each POI
**Where:**
**i** = POI to analyze
**interest POI$_i$** = degree of interest in percentage value
**score** = score assigned to each type of POI
**n** = number of times that type of POI is mentioned.

## Identification and Presentation of Parking Spaces According to the Context of the User's Vehicle

According to the user's location and where the user requires it, the user can request the closest parking lots with a radius between 1 km to 20 km around where he is, the user can filter the radius to choose. Once the parking lots are displayed at the top of the application, the user can verify the existence of space and the costs that using said parking lot would imply. The user can choose the parking lot that interests him the most and it immediately present how to go to that parking lot by vehicle. The information of each parking lot is presented, that is, the name of the parking lot, its location, and information on whether there is space available at the time of the query and the parking cost. This information can change in real time, as many times as the user

**Table 2.** Prediction results.

| Type of POI | Interest POI |
|---|---|
| Museum | 0.9775 |
| Church | 0.0193 |
| Tourist-attraction | 0.0016 |
| Park | 0.0011 |
| Restaurant | 0.0003 |

requires it and where he is and when he needs it. To carry out this parking service, it is necessary to use services or microservices that are published, many are free.

## RESULTS ANALISIS

As reported, a mobile application was developed, where the inferred interests will be presented, the POIs that represent them, the route to each one of them and the assistance to parking lots. The application will be tested in the city of Newcastle, which is in the United Kingdom. The results start with the request for permission to access the data of the user and extract the posts from the users Facebook account. Figure 2 to the left shows the inferred interests and allows the user to include other interests to later present as POIs. Figure 3 shows at the top the best POIs deduced from the inferred and specified interests.

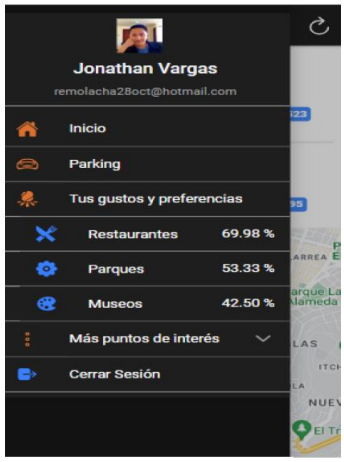


**Figure 2:** Like preferences.

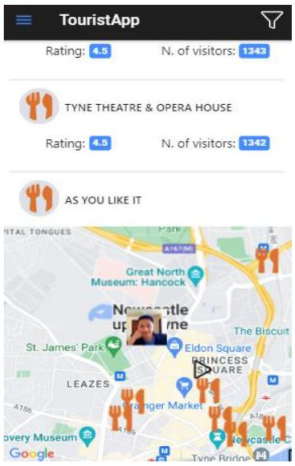


**Figure 3:** The best POIs.

Once the tourist chooses the POI to visit, they have two visit options, on foot or by vehicle; Figure 4 shows the route by vehicle. They can toggle between the two alternatives, and the route is recalculated as specified by the option. If the user requires parking spaces, Figure 5 at the bottom shows all the parking spaces within a radius of 1 to 20 km. Next, the parking spaces that are full are shown in red and those that have them in gray parking availability.


**Figure 4:** Vehicle route.

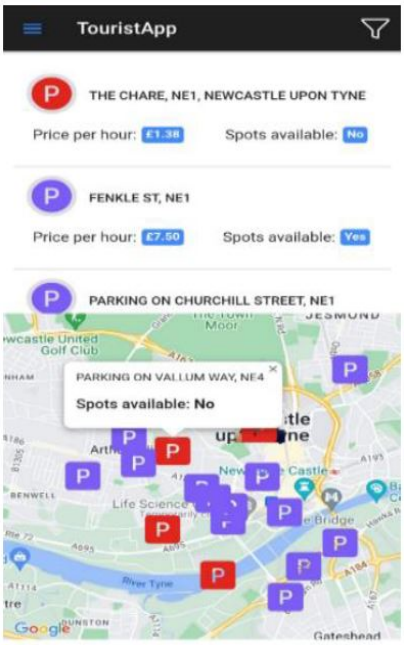


**Figure 5:** Parking space found.

Figure 6 shows the request for the necessary data to calculate the price that the use of the chosen parking lot would imply, it is necessary to specify the date and time of entry and exit. With these data, Figure 7 shows the route and the cost of using that parking lot.

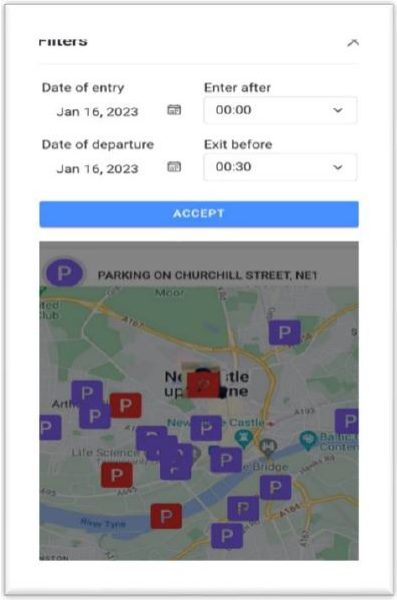


**Figure 6:** Data specification to calculate parking price.

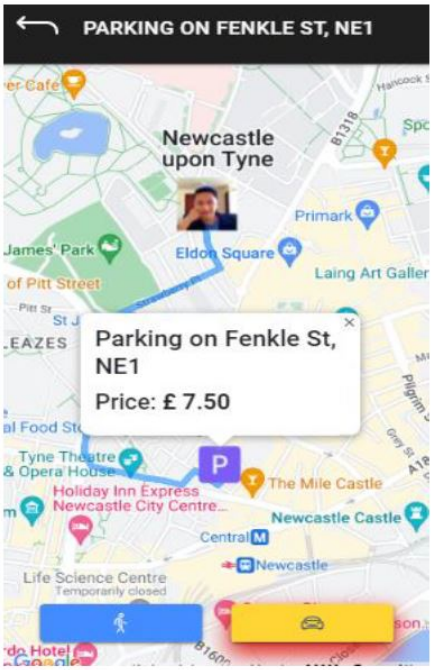


**Figure 7:** Price of parking.

## CONCLUSION

In conclusion, it should be noted that an TRS cannot be raised if some form of identification of the user's interests is not observed. The way we have exposed is interesting because it is an alternative that we have not found in any other document, since it specifically identifies user interests in real time. Additionally, the possibility that the user can change the route to be traveled on foot or by vehicle is an important alternative for a tourist. Complementarily, the alternative of identifying parking spaces that can be analyzed in real time to identify available spaces in the chosen parking lot and required costs has been presented.

It is important to clarify that the offer of available parking spaces is subject to the existence of services published in real time; the non-availability of this service limits the proposal presented.

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