

# **The Unbiased & Interactive View of Tourism Data to Tourists for Making Informed Decisions**

(Progress Report – Team #30)

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## ***ABSTRACT***

*Making sense of the vast amount of online digital data is always challenging, even more so when a tourist starts planning her/his next vacation. Travel web-sites and social media forums either have commercial interests or biased personal opinions presented as advice or recommendations. Our solution provides prospective tourists with information collected from government, commercial and social data sources and presents it through a unified interactive web-based graphical interface.*

## **1. INTRODUCTION**

Tourism is one of the fastest growing industries impacting multiple socio-economic dimensions such as transportation, hospitality, local arts and craft and related e-commerce. Any individual can be classified as tourist when she/he voluntarily leaves normal surroundings of residence to visit another environment. The internet has had a major impact on tourism both for the service providers and the consumers. Tourists today have access to a vast amount of digital information distributed across the internet on commercial, public and government travel-websites, social media-websites and personal or public blogs/forums.

With the world getting smaller by the internet, travelling around the world is also getting much easier. Although many trip planner applications are available freely, there is a lack of approaches in unbiased data visualization. Our objective is to collect information through various sources and provide interactive view of the data to tourists that is customizable to their personal preferences.

## 1.1 Motivation

The primary motivation driving our solution is that every tourist is different and thus different factors such as travel/vacation budget, tourist density, crime rate, safety, pollution levels, number of attractions, social sentiments etc. weigh differently for each. Thus, **our solution does not give travel recommendations** but provides an unbiased interactive visual snapshot of travel related information allowing the tourists to shortlist travel destinations based on their personal preferences.

## 2. PROBLEM DEFINITION

There are two major challenges that tourists currently encounter while planning their next vacation. First being that information on different travel destinations is distributed all over the internet with no single unified view. Secondly, the tourist websites although provide an overview of the travel destinations, the information is modelled to favour the underlying commercial interests.

Our solution intends to provide tourists a unified tourism related data through a visual and interactive interface. Through a web interface the data available across freely available government websites, social forums and free commercial APIs is aggregated to create a holistic view of the information subdivided into six major categories viz, tourist attractions, overall travel budget, tourist's personal preferences, social media sentiments, seasonal tourist density and government/publicly issued travel advisories. The simple visual interface allows tourists to quickly peruse a large amount of information and shortlist possible travel destinations for their next vacations based on their personal preferences.

## 3. RELATED WORK

### 3.1 Internet's Impact on Tourism

After proliferation of Internet usage, travel and tourism section has seen dramatic changes in its business model [1][2] and also in the form of user generated travel contents through blogs and review [5][6]. The consumer has access to travel related information, competitive price offers while sitting in the convenience of her/his home. The downside of this convenience is the biased view of the data presented by these commercial sites based on consumer behaviour [3]. Our proposed solution intends to present data in an unbiased form that can be directly consumed by a tourist through interactive interface.

### 3.2 Big Data Analytics

Tourists today do not want to be a passive consumer; they seek for the co-creation and personalized services. Big data analytics allows to push classic electronic consumer relationship management into new levels [7] [8] [9].

Ping et al. [10] proposes tourism demand forecasting hybrid system combining FCM clustering method with logarithm least-squares support vector regression with genetic algorithms (LLS-SVRGA).

Ulrich et al. [11] presents a comparison of predictive accuracy between univariate and multivariate models. While another method [12] proposes an ANN-based forecasting method named C-C-ANN that considered the sequence patterns and near characteristics of a data series.

Woodside et al. [13] explores relationship between values and holiday preferences through questionnaires. The result shows correlations between individual values and types of destinations. The finding is useful to us in providing an evidence in the connection between user characteristic and holiday preference.

Joshi et al. [14] describes a travel system meeting tourism need in India. We will further expand the idea globally by looking at global data source such as Expedia.

Stefanidis et al. [15] introduce the paradigm shift in the Web from a document-centric infrastructure to an entity-centric organization of data. In a recommendation system, entity-centric data is required.

Lim, K.H., Chan, J., Leckie, C. et al. [16] present in their paper same problem set as our project but in a different approach. Their paper is focused on concepts of ideas and implementation of recommendation algorithm, while our project will mostly focus on data collection and visualization.

### **3.3 Social Media and Tourism**

Matsuo et al. [17] proposes two ideas for tourism informatics, which inspires the constitute of our project backend system. The first one is to make use of geotagged user-generated content, which can replace tourism information manual maintenance by collecting location-based data from millions of Tweeter users. The second one is using data from Foursquare for tourist spot categorization. We will look at another social platform Reddit, extracting tourist information through its community, comment, and voting, to deduce the popularity and potential target audience.

Teare, Richard et al. [18] highlights the importance of the use of user-generated content from social media from the aspects of millennials growth, mobile's popularity, dynamic pricing and marketing shift. While it further roadmaps our development with the use of social media and any sites with UGC like Expedia, we will also look at statistic data from officially recognized international source to avoid commercial leaning. World Bank is the major source we will look at for deducing density of a country.

## **4. PROPOSED METHOD**

### **4.1 Intuition**

Current tourism websites are information systems where users have to read and consolidate information from different sources in order to make an informed decision. These websites, although account for personal preferences, introduce commercial bias when making recommendations. They also tend to introduce a small bias towards the preference of people who are more likely to be vocal on such platforms.

Our solution relies on two simple premises, that every tourist is different and if presented with relevant information in a simple graphical interface, without any commercial bias, tourists can intuitively decide on a travel destination that is closest to their personal preferences.

## **4.2 Why should it be better?**

As stated earlier, travel information or planning sites usually tailor raw data to achieve commercial profits while the unbiased sources of information such as wiki, WHO, World-Bank etc do not provide a single consolidated view or interface. Our solution intends to fill this void by collating following government/public data collected through World Bank, GoogleQuery, local weather stations, Reddit etc and presents it through an interactive visual interface:

- Tourist attractions
- Tourist density
- Consumer Price Index
- Weather conditions
- Transportation Index
- Crime Rate Index
- Tourist Safety levels
- Pollution/Air quality levels
- Reddit sentiment analysis score
- WordCloud on tourist reviews

### **4.2.1 Innovations**

- Currently no other tourism related solution provides such unified view of information distributed across several public/government databases
- Unlike Wiki (Voyage), our solution provides data in an interactive graphical interface
- Multiple indexes are scaled and baselined for easier user appreciation
- Sentiment analysis of user comments on reddit is presented as positive/negative sentiment percentage eg., *Paris [79% positive, 21% negative]*
- WordCloud gives user a quick snapshot of high frequency keywords related to a chosen city

## **5. APPROACH**

### **5.1 Obtaining Raw Data**

5.1.1 The World Bank provides free access to a large number of reliable databases and thus was selected as primary data source for following information:

- Tourist density (low, medium, high) based on the arrival/departure of number of tourists
- Consumer Price Index based on tourists' spot expenditure data along with regional price index
- Average temperatures and weather conditions based on historical data

5.1.2 The Numbeo is the world's largest database of user contributed data about cities and countries and was selected as data source for following information:

- Crime Rate Index based on number and nature of crimes reported across the cities
- Safety Level Index based on number and nature of crimes reported against the tourists across the cities
- Transportation Index based on availability, ease of travel and cost of traveling through public transportation in the city

5.1.3 The real-time air quality and city's pollution level data is obtained through APIs provided by [aqicn.org](http://aqicn.org) for data obtained from AirParif - Association de surveillance de la qualité de l'air en Île-de-France.

5.1.4 The Sygic agreed to provide API access for the purpose of student project for a limited period (Jul 2019). This acts as basis for all the information related to list of tourist attractions in following broad categories:

- Discovering
- Eating
- Nightlife
- Outdoors
- Family
- Relaxing
- Shopping
- Sightseeing
- Sports

5.1.5 The Google BigQuery cloud public dataset for Reddit comments since 2015. The dataset is over 250Gb and was first filtered on 'Travel' subreddit to get around 15 million user comments. This was then used for location based sentiment analysis and frequency based WordCloud of popular keywords.

5.1.6 The request for API access for hotels, flights etc to several service providers was rejected since the access was only available for commercial purposes and thus not included in the scope of our solution.

## **5.2 Algorithms**

### **5.2.1 Data Pre-Processing and Multisource Data Association**

The data obtained from public data sources is not free from errors and inaccuracies and thus requires pre-processing to improve data quality. The pre-processing was also required to scale various indexes to a common scale for easy of interpretation. The data pre-processing was carried out using R data libraries while the real-time data is processed using JavaScript.

To integrate heterogenous data from multiple sources a simple **deterministic record linkage** algorithm was implemented in R and data was added to a common database with city code as the primary key.

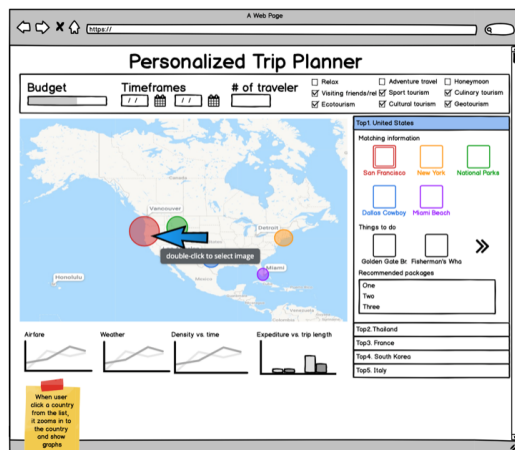
### 5.2.2 Sentiment Analysis and WordCloud

- Data Source: Google BigQuery Reddit dataset
- Data Size: ~250 Gb
- Total records: ~15 billion
- Records in “Travel” subreddit: ~1.5 million

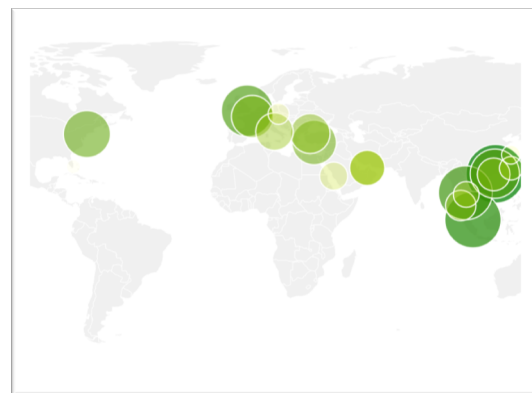
Due to large size of the dataset, sentiment analysis was carried out offline using ‘Tidy Text’ package in R with AFFIN lexicon for top 100 tourist destinations. The score for each country was scaled to percentage positive/negative comments.

WordCloud for high frequency keywords appearing in the user comments for each city was also created offline using ‘Tidy Text’ package in R.

### 5.3 Web Interface



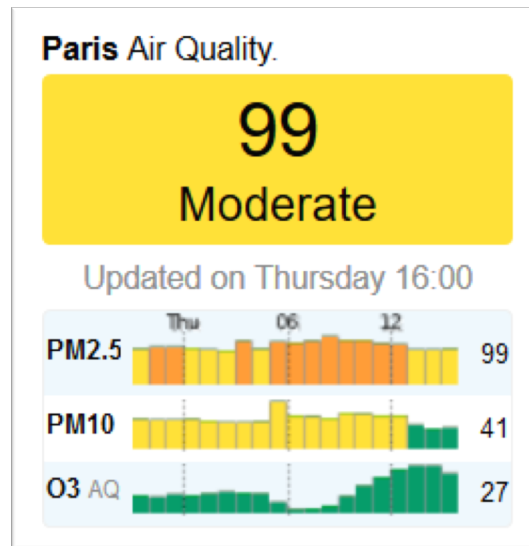
**Figure 1.** The web-interface will present data from multiple sources in an interactive environment.



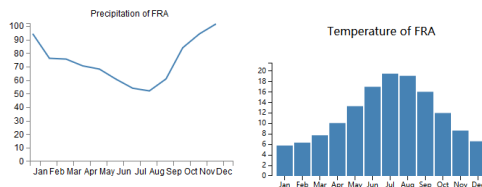
**Figure 2.** Landing page highlights locations based top-level user preferences.



**Figure 3. The attraction score is based on number of tourists attraction matching with the user's preferences.**



**Figure 5. Realtime air quality data for the selected city**



**Figure 4. The weather and temperature data received from World Bank datasets.**



**Figure 6. WordCloud with high frequency word roots appearing in Travel SubReddit user comments.**

### 5.3.1 Website Hosting - Amazon Web Services

Web Server		Database
# of CPU	1	1
RAM	1GB	1GB

<b>Memory</b>	30GB	20GB
<b>Package</b>	Php7.2/ Apache HTTP Server	MySQL5.2
<b>Host</b>	<a href="https://ec2-3-210-52-157.compute-1.amazonaws.com">ec2-3-210-52-157.compute-1.amazonaws.com</a>	<a href="https://mytestdb.cen3rhkl2zlv.us-east-1.rds.amazonaws.com">mytestdb.cen3rhkl2zlv.us-east-1.rds.amazonaws.com</a>

### 5.3.2 Libraries for Dynamic Data Driven Documents

- D3 JavaScript library v5 for interactive web interface
- DataMaps library – customizable SVG map visualizations

## 6. EVALUATION

Our measure of success will focus on the voice from outside. We have divided project evaluation from volunteers and external users in three distinct stages:

- Preliminary user preferences survey [50 volunteers]
- Midterm user review of the draft version of our solution [10 volunteers]
- User review of the final version of our solution [10 midterm + 5 new volunteers]

### 6.1 Preliminary User Preferences Survey

This survey was carried out during the initial design stage by distributing a set of questionnaires to limited number of volunteers. The aim of this survey was to identify relative importance of factors or preferences to a tourist while planning their vacations.

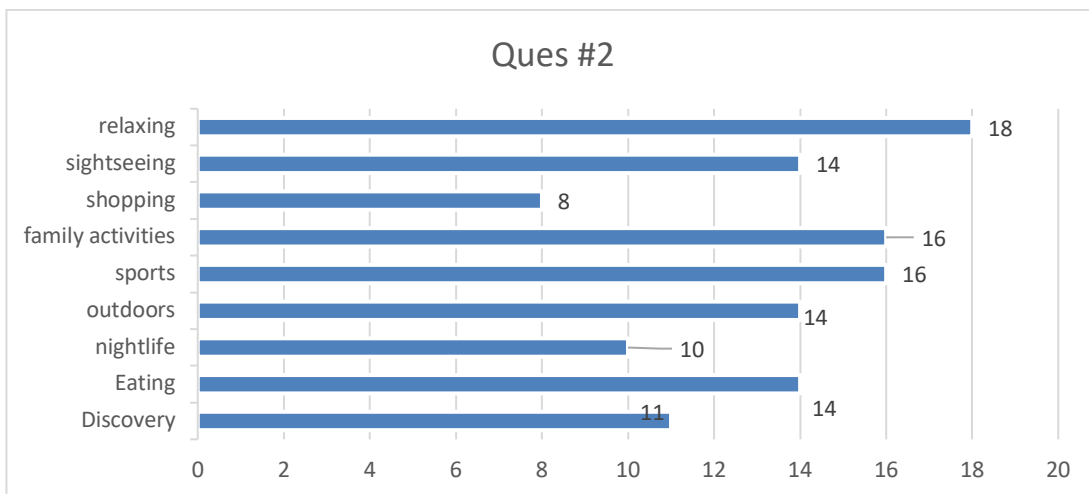
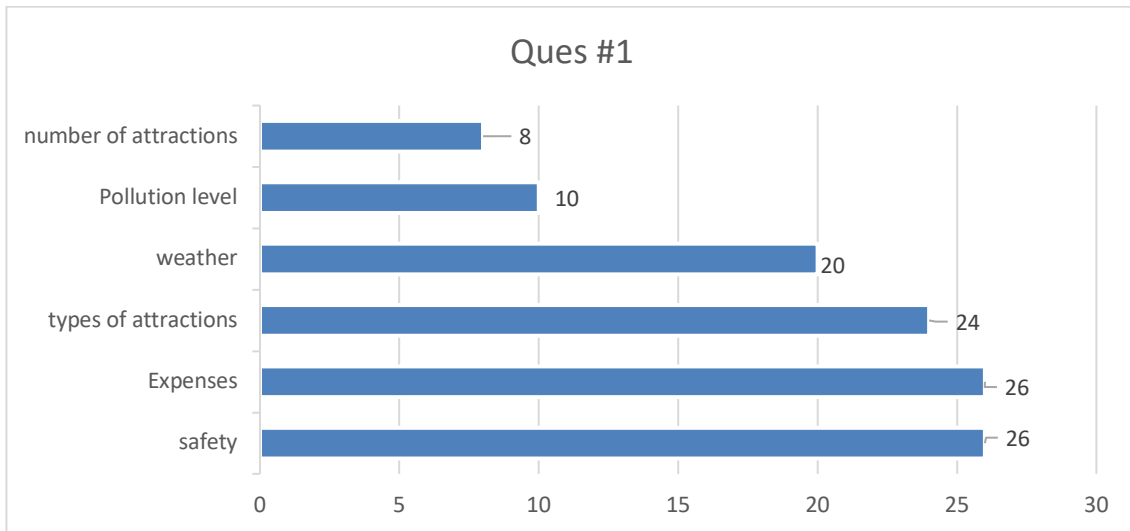
*The results from the preliminary survey were used in deciding the information to be included in our solution.*

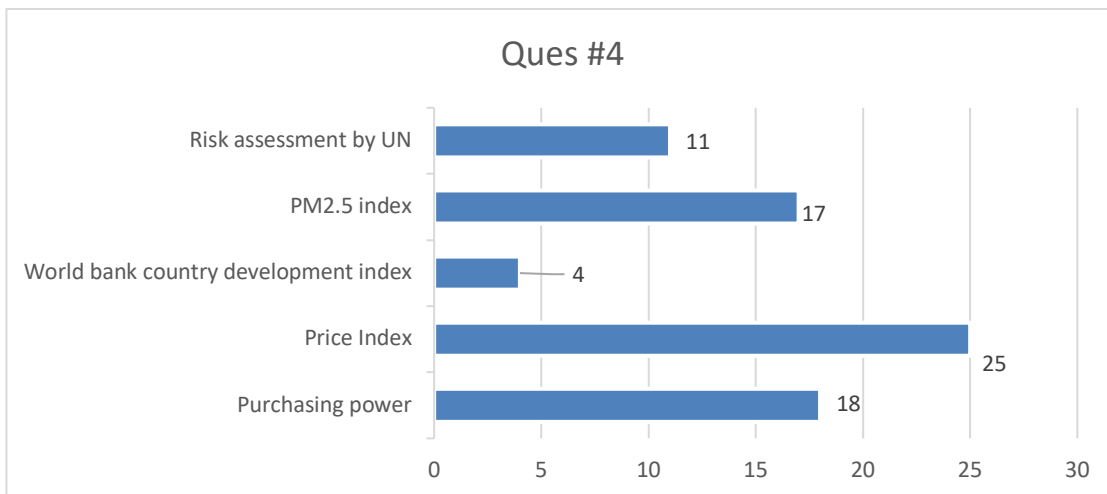
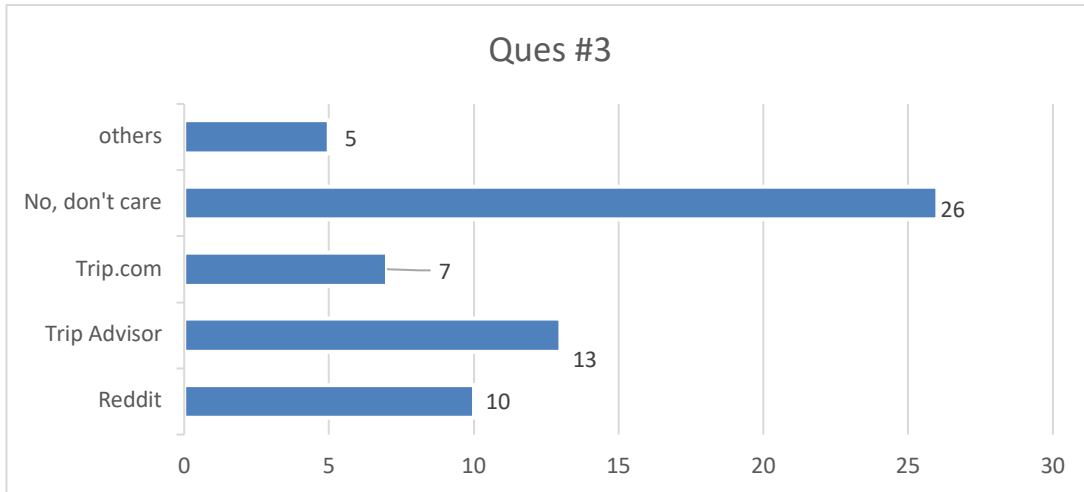
#### 6.1.1 Questionnaire

<b>Ques 1</b>	What information would you consider most important for deciding your trip?
<b>Options</b>	Expense, type of attraction, weather, safety, pollution levels, ...
<b>Ques 2</b>	What type of attractions are important to you?
<b>Options</b>	Discovery, eating, nightlife, outdoors, family activities, ...
<b>Ques 3</b>	Will comments of social media affect your decision of picking a vacation spot?
<b>Options</b>	Reddit, Trip Advisor, Trip.com, No – don't care
<b>Ques 4</b>	What type of information is "unbiased" to you?
<b>Options</b>	World Bank Price Index, UN Risk assessment, PM 2.5 Index, ...



### 6.1.2 Survey Response Statistics





## 6.2 Midterm User Review

The draft version of our solution was shared with 10 volunteers for review along with a simple questionnaire. The survey questions were designed for user to evaluate destinations shortlisted through our solution against their previous vacation.

***The result from the mid-term review gave us an estimate of the usability of our solution and changes to be made in the final version.***

### 6.2.1 Questionnaire

<b>Ques 1</b>	How would you rate the usability of our solution?
<b>Options</b>	Poor [0] ... Very Good [9]
<b>Ques 2</b>	How close did the list of shortlisted destinations match your expectations?
<b>Options</b>	Poorly [0] ... Strongly [9]

<b>Ques 3</b>	When compared to your previous vacation, how strongly do you feel that our solution could have helped you reach a more informed decision?
<b>Options</b>	Poorly [0] ... Strongly [9]
<b>Ques 4</b>	Name one data or feature that would you like to be included/removed in the final design.
<b>Options</b>	Included: [Text], Removed: [Text]

### 6.2.2 Midterm Survey Response Conclusion

- An average usability score of 5.2 was below expectation. Design changes being made to the final version for more intuitive user flow
- An average score of 8.0 indicated that the list of shortlisted destinations matched closely to the user expectations
- An average score of 7.5 indicated that users appreciate the addition of information such as safety, price index, attraction
- There is a consistent demand to include flight and hotel data while precipitation/yearly weather data was not considered very useful

### 6.3 Final User Review

- To be included -

## 7. CONCLUSION

- To be included -

## 8. Project Task Arrangement

Name	Time Allocation (Proposal) (hrs)	Time Spent (Progress Report) (hrs)	Tasks Assigned
Ankur Agarwal	120	70%	Research, Architecture, Report
Brian Ng	120	70%	Research, Application
Si-Onn Kwok	120	70%	Research, Recommendation System
Xiaoqi Zheng	120	70%	Research, Front End
Yiufung Leung	120	70%	Research, Social Media Analysis
Youjung Kim	120	70%	Research, Backend

**Table 2. Proposed task allocation and approximate time estimates assigned/spent to each member of the project team.**

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