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Smart Location-Based Tourist Places Recommendation System

Vignesh Hariharan K[1], Santhosh S[1], Sailappan E[1], Prabavathy Balasundaram[2]
[1]UG Student, Department of CSE SSN College of Engineering Chennai, Tamil Nadu, India
[2]Faculty, Department of CSE SSN College of Engineering Chennai, Tamil Nadu, India

ABSTRACT

This paper proposes a novel tourism application that provides personalized location based recommendation of tourist places. The application consists of two modules, namely Ranking of Places and Tour Guidance. The first module takes user preferences and data from Tripadvisor to provide a ranked list of recommended places using a Hybrid Algorithm. The ratings are given using a weighted average approach. The tour guidance module acts as the interface for the user by devising an interactive and dynamic tour plan. The application receives input from the user regarding his request for a tour plan. The user is provided with recommendations, keeping in mind the preferences of the user, live information and popularity of places. Efficient routing between these places is done with an azure maps API which denotes the places visited and the places yet to visit. The user interface consists of a map where the user can click on the place he wants to visit and can go on visiting places nearby.

Index Terms—Tourism, Selenium, azure maps, Web Scraping

I. INTRODUCTION

Tourism plays an important role in the socio-cultural integration of a country. While domestic tourism encourages intermingling of members of different communities, international tourism leads to the creation of an international understanding regarding the culture, traditions and values of tourist destinations. A country like India has huge diversified culture, varied customs and traditions which result in a lot of tourist attractions exhibiting their culture. According to India Brand Equity Foundation, total contribution by travel and tourism sector to India's GDP is expected to increase from USD 234.03 billion in 2017 to USD 492.21 billion in 2028. As of 2019, 4.2 crore jobs were created in the tourism sector in India, which was 8.1 per cent of the total employment in the country.

It is clear that tourism is very important for India and it has taken various steps to support this industry. As lucrative as the joy of visiting a new place is for the tourists, it often comes with its own pain-points. The main problem that tourists face is the difficulty in navigating through the places of visit. Tourist guides are the obvious choice but they have also been known to loot the money of these tourists. In response to this, there have been a few tourist guide applications that help the users in recommending places of visit. The choices

recommended to them, though popular, does not keep in mind their personal interests and live contexts such as weather, closing times. This often frustrates users who, for example, go to a temple to find it closed in the afternoon. There is a need for a system which addresses these issues to make their tourism experience better.

II. LITERATURE SURVEY

There have been various attempts to solve the problems of tourists navigating between places of visit with the help of software applications. Scholars have proposed systems based on various techniques like Collaborative Filtering, Content- Based Filtering, Bayes Theorem, Artificial Neural Networks and the like to recommend places. On the other hand, there have been numerous applications developed by companies like Tripadvisor, Airbnb to improve the travel experience of the tourists by solving some painpoints of tourism.

A. Research Papers

Colace et al. [1] modeled a context aware system to provide information depending upon the current context. The context is to characterize the situation of an entity such as a person, a place. This paper conveys the importance of technologies like IoT, cloud and mobile computing in the development of tourism. The system requires certain pre-requisites such as data on important places, restaurants, multimedia guides, special visits, weather, timetable of local transport and other public information. The prerequisites are stored in a database which retrieved by system based on contextual information and user preferences. The output of this system will be textual information regarding the context.

For example, if a person likes fish food, only this kind of restaurant or menu will be proposed. The architecture of this system consists of a context-aware module, Knowledge base and a management module (for managing the application). This system works by the dynamic invocation of items during the execution of the specific instance of the program. The invocation is either in response to a user request or change in contextual information. For example, an invocation occurs if there is a change in the weather. The dataset is populated from Facebook and Tripadvisor with their APIs with six dimensions, ie. 5W1H. If a person walks by some place, he will be notified of it. If he is interested, he can know more or else he can dismiss the suggestion. Google Maps is used for visual representation. The data structure used here is a context dimension tree which is composed of a triad (r; N;
A) where r indicates its root, N is the set of nodes of which it is made of and A is the set of arcs joining these nodes. This tree has dimension nodes which denotes the dimensions and concept nodes which denotes the value.

Kbaier et al. [2] proposed a hybrid recommender system with uses the collaborative filtering (CF), the content-based filtering (CB) and the demographic filtering (DF) methods. To improve accuracy, the system uses Switching and Weighted approaches of hybridization. Collaborative filtering and Content Based Filtering uses k-Nearest Neighbours and Demographic Filtering uses Decision tree. The goal of this system is to prove that the Hybrid method is better than other methods. The system was built due to the vast amounts of non-personalized information available on the internet and to help the users having difficulties in making choices. Tripadvisor data for the city of Paris is used as a dataset because in Tripadvisor, there are 20 possible styles for each activity and hence the output will be highly personalized. The user's request for a recommendation is taken as the input and a personalized recommendation list for the tourist is given with the help of user references and ratings dataset. The recommender system uses a hybrid recommendation algorithm, which is a combination

of these three methods (CF,CB,DF) by maximizing the good in them and eliminating the bad features. This algorithm uses two approaches, switching and weighted. The hybrid algorithm acts in the following way. If no cold start situation is detected, it uses the average weighted sum of DF, CB and CF results. If a new user cold start situation is detected, it uses the DF recommendation result. If a new item cold start situation is detected, it uses the CB recommendation result. The distance between two users is computed in order to determine the neighborhood using Tanimoto Coefficient for this dataset. This system offers highly personalized recommendations to their users and have historical data along with user preferences to provide the recommendations list.

Bahramian et al. [3] introduced a hybrid interactive context-aware tourism recommender system that takes into account user's feedback and additional contextual information.

The system offers personalized tours to the user based on his/her preferences using the combination of a case based reasoning framework and an artificial neural network. The proposed system suggests tours to each user who wants to plan a tour in two regions, containing 55 places of interest, of Tehran with 20 students as the user. The architecture of this system consists of a contextual information module and a tourism recommender engine. The input for this system is the feedback that users provide and their previous tour history. The output is a personalized and context aware tour recommendation for the user. The system is developed in three successive steps where system learns the current user model and recommends n new tours to the user based on the current user model and some contextual information. The user selects (or rejects) a tour among the recommended tours and assigns a rating to it as a feedback. The feedback on the selected tour elicits the user's needs. This feedback is case based rather than feature-based. The system revises the user model for the next cycle using information about the selected tour and n similar tours. This is achieved with a hybrid recommender system that applies Artificial Neural Network (ANN) (as a content-based recommender) and Case Based Reasoning (CBR) (as a knowledge-based recommender) in a homogeneous approach. It considers contextual situations in the recommendation process including POIs locations, POIs' opening and closing times, the tours already visited by the user, and the distance traveled by the user. Moreover, it considers the rating assigned to the visited tours by the user as user preferences and feedback. It also takes into account both POIs selection and routing between them simultaneously to recommend the most appropriate tours and is not limited to recommending tours that have only been previously rated by users. The proposed method combines CBR and ANN and exploits the advantages of each technique to compensate for their respective drawbacks.

Srisuvan et al. [4] proposed a personalized recommendation system for e-tourism by using statistical techniques based on bayes theorem to analyze user behaviors and recommend trips to specific users. Past and recent information of customer's behaviors are used for recommending products and services best fit to relevant customers in e-Tourism. The system used two databases. One is the Trip database which contains 75 relevant trips with each trip having five features which include type, number of days, zone, price and season of trips. Another is a user transaction database which includes user behaviors on web usages which are data of user selection on relevant trips, the feature of relevant trips and the selected feature values. The system works by letting the user to select the relevant trips or feature of relevant trips from the provided website. Then, the system keeps the data usages on the transaction database and uses Bayesian learning to analyze and learn user behaviors. The system then

learns important features of the relevant trips from user behaviours. The probability that the user selected each feature of relevant trips in the database would be calculated using a formula.

The trips from database are ranked according to their RT values.

Thenmozhi M et al. [5] proposed a Framework for tourist recommendation system by exploiting geo-tagged photos. There is an increased tendency to utilize the information contained in the geo-tagged photos available in social media sites such as Instagram for tourist recommendations. The proposed approach involves mining significant tourist locations and providing a trip model based on the geo-tagged photos of users on social media sites. The first step involves the collection of geo-tagged photos which serves as the input for the recommendation engine and identifying the locations from these photos. The locations that are present are annotated using a scoring algorithm using a specific tag. For these annotated locations, the corresponding photos are obtained to profile the locations by sorting of locations based on number of visits and timestamps and comparison of users based on locations. In order to provide top–n recommendation to a particular user, the ranking algorithm is based on the general popularity score, user's current context and his personal interest about the location.

Hao et al. [6] analyzed the state of art of mobile cloud computing architecture, describes the application scenarios, and points out the main problems existing during the applying process of mobile cloud computing. The main reason why we need to host mobile applications in the cloud is due to less computational capability, battery constraints, device speed, processing power and the like. Mobile cloud computing takes advantage of the abundant cloud resources to complete computation-intensive tasks. The paper discusses 4 architectures in the cloud. In a remote cloud architecture, mobile devices obtain resources and services from a remote cloud data center and computation intensive jobs are performed in the cloud and the results are returned to the mobile application. The main idea of cloudlet is to deploy the cloud infrastructure near the location of mobile devices, so that mobile devices can access to the cloud in the way of low latency, high bandwidth and single-hop. Cloudlet is not suitable for our system since the mobile devices move a lot. Internet connectivity is not essential in this situation. The third architecture is that of an Ad-hoc network where a group of devices near each other form an ad-hoc network to use other devices' idle resources. This is only suitable in some situations. Ad-hoc networks require a group of devices at all times and there is a problem on how to encourage users to act as resource providers and hence is not suitable for this system. If we combine the three architectures in a reasonable way, we can achieve a more ideal effect to remove the limitations. This is called as hybrid cloud architecture. The use of hybrid architecture can provide better services for mobile users, but brings the problem of high complexity. Hence remote cloud architecture is the best choice for this system. The only limitation with remote cloud architecture is that connectivity to the cloud is always unstable and how to guarantee the normal operation of the mobile application is a difficulty in the case of a sudden loss of connectivity is yet to be figured.

B. Products (Web and Mobile Applications)

Quite a few applications have been developed by companies to tackle the problems faced by tourists. Apps like Oyo and Airbnb have been effective in providing accomodation for the visiting tourists whereas GoIbibo makes flight booking easy. Tripadvisor provides you complete information about places of interest and Google Maps helps in navigation. With a plethora of options for the users to choose from, the authors discuss the features of three

applications - Tripadvisor, Google Maps and Wanderlog.

Tripadvisor is an online travel company that lets you search for things to do, view millions of traveller reviews and opinions, write reviews on various places of interest. It is also used for booking popular tours, book hotels, reserve tables at restaurants. It is available both as a website and as a mobile app. Google Maps is the popular mapping service that allows the user to search for places and get the routes to reach them. This service has been very helpful for tourists to navigate themselves to a particular place. In addition, it also shows real-time traffic information and re-routes according to the context. Wanderlog [9] is a travel planner app that allows users to build, organize, and map their itineraries. It provides features such as adding places to visit, importing flight and hotel reservations, getting personalized recommendations and exporting the places to Google Maps. The application recommends places for the chosen city based on online blogs, allows the user to add personal notes and invite people to plan the trip together.

C. Limitations

The aforementioned systems are trying to solve the pain-points in tourism but these systems suffer from certain limitations.

Colace et al. [1] classifies places into various categories and suggests based on the categories. However, the system does not exploit the data from Geo-tagged photos posted on social networks like Instagram, does not constantly update the historical data and does not update user's preferences based on their own history. The system also does not provide with a tour plan and just recommends the places of visit. Kbaier et al. [2] does not provide very up-to-date and trending information and does not take into account live information such as time, weather and other user preferences to make context-aware recommendations. Bahramian et al. [3] does not provide an intuitive Google Maps based User Interface for routing and does not consider the live information of the places before recommending. Srisuvan et al. [4] suffers from a severe limitation, that is the system recommends pre-planned trips that users prefer rather than planning a new trip based on user's preference. There is no provision to update these pre-planned trips dynamically and does not consider live information of the places. The system also does not provide routes for the recommended trips. Thenmozhi M et al. [5] simply ranks the tourist places and does not provide the user with the efficient route to visit the places. Also, it does not consider the user's history, live information and provide an intuitive, map-based User Interface for the user.

Tripadvisor is the most used application for finding out the best places to visit with respect to the reviews given by users. However, it does not provide an end-to-end support for the user throughout his travel. It also won't show climatic and live information, does not guide users based on opening and closing times and does not provide a route to visit these places. It does not consider the preferences of the user before providing a list of things to do in a place. Google Maps, while providing suggestions and navigation between places of interest, does not account for user's preferences and certain live information. It does not allow the user to plan tours ahead of schedule. Wanderlog covers a lot of things that is expected from a tourist application but the application does not provide suggestions for places of visit and instead just lists all the places crawled from the web.

D. Motivation

While planning a tour, the user usually has to gather infor- mation from different sources, read the reviews and choose the relevant places to visit. This involves a lot of research and time to plan for the tour. If any unexpected event occurs after planning such as closing of places due to a pandemic or political

reasons, then the plan has to be changed. This cannot be done easily in most of the existing systems. While the above discussed systems and applications proposed various ways to solve this problem, each has its own limitations regarding personalization, context awareness, dynamism and user intuitiveness. Thus, there is a need for a system that propose plans for the tour according to the preference of the user and also dynamically changes the plan in case of any unexpected events.

III. PROPOSED SYSTEM

Existing systems have tried to recommend tourist places for tourists but often face the limitations discussed. Systems have used historical data such as reviews from websites like Tripadvisor [7] in a Collaborative filtering approach, calculate routes to places of interest, include context awareness in their systems and also proposed Hybrid Algorithms. There is also a need for dynamic updation of the recommendations if the user decides to change his preferences or in the event of any live changes like climatic conditions.

Our proposed system aims to resolve the limitations by including all of the above mentioned parameters for recommending tourist places. The recommendation thus obtained will be highly personalized, context aware, popular and dynamic. The system also aims at exploiting the potential

of Tripadvisor data and Google Reviews to understand the popularity of the general public. The list of places to visit in a particular location will be retrieved from Tripadvisor and will be ranked based on Users' preference and Google Reviews. The design of the smart location-based tourist places recommendation system is shown in Fig. 1

The system also attempts to provide a tour plan by establishing routes between the ranked list of places for the user. This is done with the help of azure maps [8]. Keeping the user experience in mind, an intuitive azure maps based user interface depicting the places and routes will be developed in a Flask web application. The user has the choice of choosing his preferred placed based on the choices provided to him. Since most of the trips aren't done alone, the application will provide an option to input the preference of each member of the tour plan and devise a plan that will accommodate every person's preference. The rankings are recalculated once the user(s) has/have made a choice to visit a particular place so that the next place to visit can be determined. The proposed application will guide the user throughout his/her journey, starting from planning the tour out to reaching his/her home.

The proposed system contains two modules, namely ranking of places and tour guidance. The ranking of places module is further divided into two parts, one part gets the places of interest and another part gets the user's preferences. The ranking of places module has places of interest and prefer- ences sections along with Azure map implementation in tour guidance module.

A. Ranking of Places

This first module consists of providing the user a ranked list of recommended places based on general popularity and user preferences. The user enters the name of the city that he wants to visit and the application will return the top things to do in that city. This step in done in two parts,

- The places of interest in a city is taken from Tripadvisor and its popularity is calculated from Google Reviews.
- The preferred places to visit in the tour is received from the user via the application and used to rank the list of retrieved places.

1) Places of Interest:

Each city has its own attractions. Thanjavur is known for the Brihadeeswarar temple whereas Goa is surronded by beautiful beaches. However, each city has some underrated gems that are worth your time and these places are unearthed from Tripadvisor. A python program bot scrapes the Tripadvisor website for the list of things to do.This list of places is stored along with its category and are further searched in Google for its reviews. Only the top ten newest reviews are taken into account for calculating the rank.

The reviews in the top ten given a month ago or earlier are discarded. A weighted average approach1 is used to rank the places based on Google reviews. More weightage is

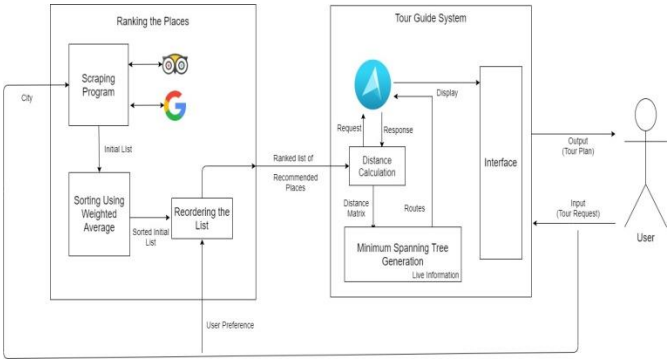

Fig. 1. The design of Smart Location-based Tourist Places Recommendation System

Algorithm 1: Weighted Average Rating

```
Result: The weighted ratings for each place
date, total rating=0;
while list of all places do
    i=0, review count =0;
    list = scraped list of dates;
    date=list[i++]
    if date less than 1 month then
        total rating = total rating + current rating;
        review count +=1;
    end
    average = total rating / review count;
    weighted average = average * review count /
    required number of reviews;
    return weighted average
end
```

given if the place has all ten reviews of recent relevancy and less weightage is given if there are fewer number of recent reviews.This list is then subject to reordering based on the preferences of the users.

2) User Preferences:

It is not only important to retrive popular places of interest but also very important to pay heed to the preferences of the user. For example, Kapaleeshwarar temple is a famous place of interest in Chennai but this suggestion might not be useful to a person who has faith in christianity. Thus the application takes the preferences of the user, such as the user's preferences to visit temples, architectural buildings, beaches etc. The list obtained from scraping Tripadvisor and Google Reviews is ordered based on the weighted average of the places. After receiving the preferences of the user, it is ordered on the basis of places preferred with highest ratings. This final list is sent to the tour guidance module to visualize the places with the help of a azure maps user interface.

B. Tour Guidance

Once a ranked list of recommended places is obtained from the previous module, it is visualized with the help of azure maps as in Fig. 2 to provide the best route for the users between these places. The optimized route for the users is calculated by azure maps API and the algorithm used is the popular travelling salesman algorithm. Azure maps presents the shortest or fastest routes available to multiple destinations at a time or provides specialised routes for walkers, bicyclists and commercial vehicles. Here, the default mode of transportation is considered to be car.

1) Maps API:

To display the map interface of azure maps, we need to get the subscription or API key from Azure. This is done by signing up for a free account at Azure. With this key, a preliminary map is displayed. The source and destination along with the intermediate waypoints are given from the list of recommended places. The Maps' view is set based on the source and

destination. An HTTP request is sent to the API along with the coordinates of the places to determine the optimal route between them. In this report, we have demonstrated this with a single source and destination without any waypoints. The response consists of the distance and time to be travelled and the optimal route. azure maps performs route calculations with isochrones, matrix routing and batch routing.

2) Map Interface:

The information obtained from the API are visualized in the map using a HTML webpage. The Maps

Fig. 2. A map showing the route between two places

is displayed into the webpage with the javascript map control or the render API. The maps update dynamically, so that the users can get constantly refreshed information. The map interface is scrollable and zoomable which makes it easier for the users to see the routes between places. The source, destination and waypoints pins can be customized to different shapes and colours.

IV. CONCLUSION

Tourism highlights the beauty of a country, both natural and monumental. Every nation depends upon tourists to give them a source of income via tourism. For this, the tourists visiting these countries should be happy and recommend to other people. A system that helps tourists by guiding them throughout a city is the need of the hour. The system proposed in the paper does that for the user for the city that they want to visit. The user's preferences are obtained and the top rated places of interest are returned to the user. These places are displayed on a map so that it is easier for the user to navigate between these places. The system gets its information from Tripadvisor and Google to display the places on Azure maps. The user can then follow the suggestions provided for his trip and explore the city.

V. SCOPE FOR FUTURE WORK

Tourists prefer information on the go and this application is designed to handle the same. However a mobile application would suit tourists better than a web application. The mobile application can be cross platform and built using Flutter SDK. Currently a native application, the system can be migrated to the cloud to handle user load and their queries better. Cloud computing concepts such as elastic load balancing, scalability and on demand provisioning of resources makes it an attractive option for the application. More user friendly features such as choosing modes of transportation, pre- planning trips, having a to-do list and the like would improve the usability of the application.

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