Scylax – Preference based Personalized Tour Planner with Virtual Reality

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***Abstract*— Over the decades, travelling has experienced continuous growth and deepening diversification to become one of the fastest growing economic sectors in the world. Among the existing travelling applications, only a handful facilitate the ability to plan a tour which is entirely based on user preferences, while offering an in-depth look at the desired destination. Therefore, this research focuses on integrating semantic technologies, collaborative filtering and Virtual Reality into the domain of travelling and provide preferred user oriented tour plans with superlative user satisfaction. The key factor that needs to be understood is that the preferences or the behavior of one user may be entirely different from another. "Scylax" has introduced the concept of preferences and behavior based personalized tour planning and the way of exploring desired routes, major stops or attractions along the way via virtual reality 360 view experience. In addition, business organizations can use the web-based dashboard to maintain their services, offers and obtain business analytic based improvements.**

Keywords*— *Semantic-Matching; Personalized Tour Plans; 360° view; Tour Suggestions

I. INTRODUCTION

Travelling is a vastly growing field of study across the globe. People of affluent societies have always managed to travel to distant parts of the world to see extraordinary locations or significant works of art, to learn new languages, to experience new cultures or to taste new cuisine. Sri Lanka is one of the most sought-after tourist attractions in the world. It is enriched with astoundingly attractive places to visit and holds a magnificent multiplicity with its religious, cultural and historical background. Travelling is an industry which has adopted the use of modern technology to gain all these experiences. With these innovations in the travelling industry, many tend to build interactive websites for the purpose of guiding and helping travelers. Recently the term "Mobile Travelling" has come into a spotlight. What started as printed maps and guidebooks with information on travel destinations for tourists, soon converted to websites carrying hundreds of pictures, digital maps and information on various locations to visit all over the world, with the advancement of the World Wide Web, or the Internet.

Most of the current travel applications are either based on guiding the travelers by providing them with the required information or providing them with fixed tour packages. Travelers who are visiting a country for the first time or locals who have less knowledge about the sceneries or places that could be visited, will not be able to fully utilize their time and money with these available static plans. Since the preferences of users differ from one to another, a tour planned for one traveler may not be prudent to another user. The proposed application - Scylax was developed with the intention of providing a solution for the above problem. It is a preference and behavior based tour planner with Virtual Reality", It is an all-in-one package, which allows a traveler to plan their own "personalized" tours. Moreover, it provides tour suggestions based on semantic matching, collaborative filtering, and is capable of planning hangouts and reach the desired destinations easily. It filters the destinations based on user preferences and allows them to get an idea of the planned tour before actually visiting the places via Virtual Reality 360° view experience. Scylax has mainly focused on giving the opportunity of planning itineraries based on the user's personal preference by using the semantic matching concepts.

Depicted below is the life cycle of a traveler. Fig. 1 explains the phases of a traveler's life cycle as Inspires, Pre-Travel, On-Travel and Post-Travel phases. Out of these phases, Scylax places foremost concern on the "Pre-Travel" phase.

Fig. 1. Travelers' life cycle

II. LITERATURE REVIEW

Some of the travel based applications have used GPS (Global Positioning System) as the main technique of facilitating travelers with information on desired locations. LBTA- Developing a Location Based Tourist Guide Application [1] is a location-based tourist guide application for the outdoor environment. The handheld device is augmented with Global Positioning System (GPS) to provide regularly updated information about the user's current location. The main aim of this project has been to develop a context-sensitive travel expo application. This application has focused on guiding the user rather than planning a tour based on preferences. Consequently, the user has to always hold the handheld devices and it will only provide the information about nearby places. Availability of both GPS and the battery life of both devices may affect in the facilitations that have been provided.

Aurigo: An Interactive Tour Planner for Personalized Itineraries [2] is a tour planning system, which combines a recommendation algorithm with interactive visualization to create tour itineraries. Aurigo mainly tackles the efficient itinerary problem and the assisted exploration problem by finding the most efficient itineraries and rapidly creating the selected itineraries. Though they have considered the best itinerary plan, Aurigo does not address the major tour planning mishaps, such as budget, tour duration, individual preferences, opinions and user priorities. This may result in users ending up planning tours beyond their preferred budget. Since the Aurigo has considered about start and end points provided by the user, they cannot further customize the tour according to their preferences.

Intelligent Tour Planner and Advisor [3] is a web application which is capable of providing its user with a personalized tour plan. This tour planner allows its users to select the places they wish to visit while recommending where they could go based on their choices. It has consolidated the semantic web methods and technologies into the domain of tourism. Though this can be used as the framework to prove the concept of semantic technologies it has no mobility concepts and it has not integrated the heterogeneous tourist information such as accommodation, transportations. Additionally, it does not have a way of finding the best itinerary when planning tour plans.

SPETA [4] explains about tourist recommendation systems for the selection of the destinations. SPETA has been considered only the user's current location and the user's history of past locations to implement the recommendations which can be affected in accuracy while Scylax used the collaborative filtering and neighbor matching concepts which are more accurate than previous technique.

TripAdvisor [5] is a travel planning service which enables travelers to plan and book the trips. It will help users to plan their trip from the beginning since TripAdvisor has a large repository of hotel and destination reviews, ratings, photos, and other information. Similarly, it is a great site to use to plan destination getaways, long-stay holidays or to find resorts and other places you would love to retreat to. Though this has become a spotlight still it has major limitations such as less consideration about personalized user experience, not considering the best route, surrounded places and basic travel mishaps etc.

Not only TripAdvisor but also most existing travel applications give information about the preferred destinations using only text and image contents. The user may not know about the exact feeling they are going to get at the end point. Though they have planned the tours according to their preferences ultimately travelers may end up with less satisfaction due to not getting the expected perception. None of these applications has considered the fact that the user's visualizations of the planned tour may differ from the actual viewpoint since they are imagining the tour experience based on the text and image contents they refer at the beginning.

Out of the many web-based products out there, there are few such travel solutions that provide personalized travel solutions to travelers. The very basic idea of a personalized tour plan you find today is where a separated agent (person) would be allocated for the traveler to gather their preferences and plan their trip for them. This process can be quite time-consuming and on the other hand, may not be in the favor of those who do not wish to wait for an agent to contact them. Moreover, this way of personalizing a tour plan is not successful where the user wishes to create multiple tour plans. Few examples of such travel planning solutions would be Trip Trotter [6], Sygic travel [7] and Jetsetter [8].

III. METHODOLOGY

Scylax consists of a mobile application and a web application. It has been further divided into several main sub-components. Fig. 2 shows the integration of these sub-components.

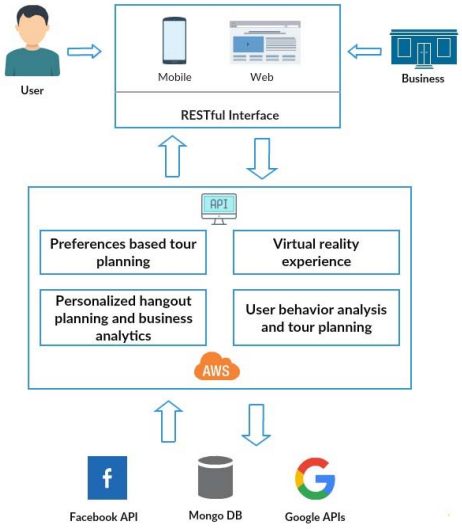

Fig. 2. System Overview

A. *Preference based tour planning*

Personalizing and providing a recommendation for a new user is a tedious task, since the system has no prior information related to the user, that it could use to personalize their tour plan or the hangout. Therefore, Scylax is designed to get the required choices or the preferences of the user, as the general

set of information, so that personalizing their preferences and recommending the best choice, is made possible.

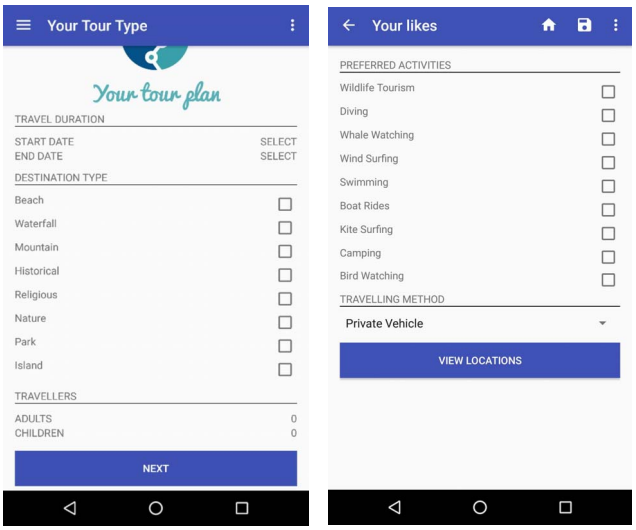

Fig. 3. Tour Planning Steps

As shown in Fig. 3 the user preferences will be collected and classified into two major categories,

- Destination Types - Beach, Waterfall, Mountain, Historical, Religious, Nature, Park, Island, etc.
- Activity Types - Wildlife Tourism, Diving, Whale Watching, Wind Surfing, Camping, Bird Watching

B. Semantic preferences matching via SMatch

1) Maintaining User profile and destination profiles

The user profiles are created dynamically when travelers provide inputs to the mobile application. After getting those preferences, a temporary user profile will be created, containing the destination features, and attraction features. This user profile should be created each and every time since the preferences of the user are most likely to change.

The destination profiles are created manually for a selected destination, which is used to match against the user profiles to determine the similarities between them, and to recommend the most likely places a user would like to visit. This manual process will not cause issues as the features of a destination, or the activities are least likely to change, unlike the preferences of a user.

2) How Semantic matching is used within the system

The semantic matchmaking algorithm that is used to match the user profile and the destination profile is S-Match [9]. It is a semantic matching framework, which provides several semantic matching algorithms to tackles the semantic interoperability problem and facilities for developing new algorithms. S-Match algorithm is an example of the semantic matching operator. S-Match was heavy to conduct experiments in semantic matching.

S-Match contains the implementation of three matchmaking algorithms: - Namely, the basic semantic matching, the minimal semantic matching, and structure-preserving semantic algorithms. Out of the three, the basic semantic matching algorithm is used in this research. The basic matching algorithm is a general purpose matching algorithm, which is very customizable and suitable for many applications.

The basic semantic matching algorithm, the semantic relations are found in the form of:

- Equivalence (=)
- Less general (<)
- More general and (>)
- Disjointness.

In this research, only the character equivalence (=) is taken into consideration when it comes to defining the similarities between the destinations, and the created user profiles.

3) Preferences Matching

As shown in Fig. 4 the user profile and destination profiles are matched using SMatch [9]. User profiles will be generated dynamically and the system has pre-generated destination profiles. For each destination profile that was matched with the user profile, it generates a result file which consists of the similarities between the destination and the user via character equivalence (=).

The weights mentioned in Fig.4 are calculated using these result files by considering the "equivalence (=)" factor. Destinations, that bear more similarities to the users' preferences, will score a higher weight. The user will then be displayed destinations in the descending order; destinations with the highest score to the destinations with the lowest score. Fig. 4 explains this overall preference matching process via semantic matching.

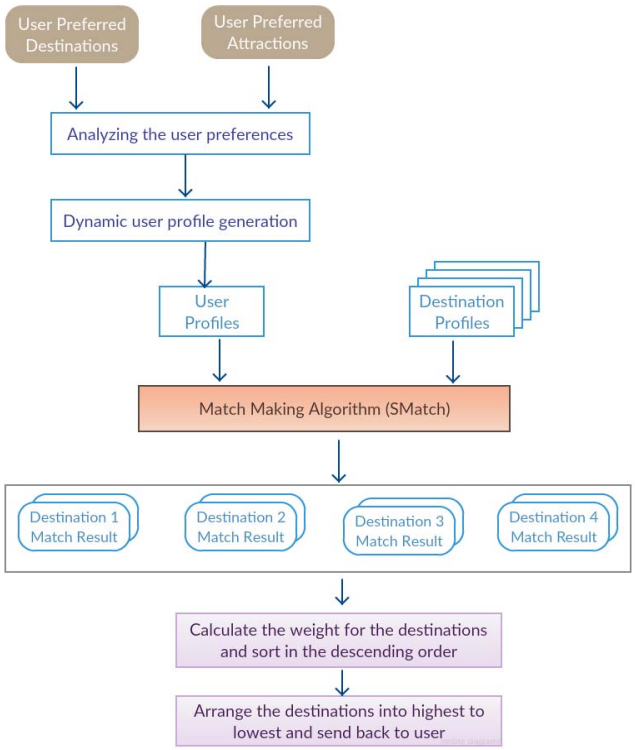

Fig. 4. Preference matching process via SMatch

The advantage of this approach is that the user need not waste time going through all the destinations offered by the system, to decide if it has what they need to see. Then the user can select the destinations that they would want to visit, which is fed as an input to the route generating process to display the map to the user with the places that were selected.

C. *Tour recommendation with collaborative filtering*

A Mahout-based collaborative filtering system used to analyze the user behavior based on the ratings given by the traveler and to recommend the pre-planned tour according to that details. The goal of the recommender system is to make place recommendations to people. These recommendations should be the places where they are more likely to travel. In a word, recommenders want to identify items that are more relevant to the specific user.

There are two basic types of recommenders as content-based filtering, and collaborative filtering [10]. This approach has used collaborative filtering which requires a data source that can tell the recommender what a set of users perceived about a group of places.

Collaborative filtering comes in a number of flavors. The two most common are item-item filtering and user-item filtering. User-item filtering will take a particular person, find people who are similar to that person based on similar ratings and recommend items those similar people liked. As shown in Fig. 5 user-item filtering has been taken into consideration when recommending places.

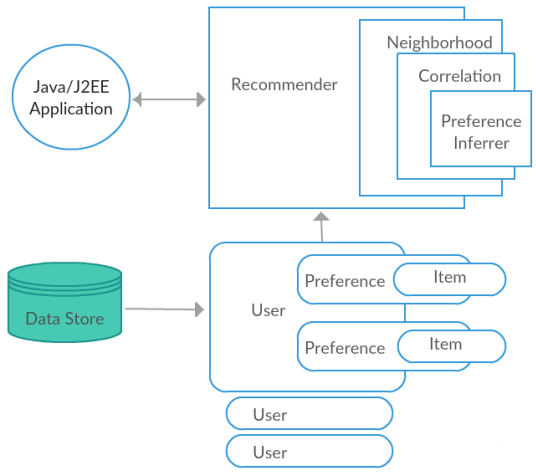

Fig. 5. Recommendation process via Collaborative filtering [11]

User-item filtering of recommendation can be used, with some manipulation, to predict how a particular person might rate an item they haven't already rated. This recommendation process works as follows:

- Take a group of people who have rated for attractions
- Calculate the "similarity index" between each pair of people based on their ratings
- Find the other people who are most similar to the user
- Recommend the destinations by considering similarity matching
- Generate pre-planned tours based on the recommended places

D. *360 ° view Virtual Reality experience*

Virtual Reality experience is responsible for the following traits of Scylax:

- Creating a VR experience using mobile devices
- Storing and retrieving VR videos from server
- Organizing a compilation of a VR experience for a tour

As shown in Fig. 6 Scylax provides a VR experience of a location the user intends to visit, before actually making the trip. When a tour is generated via preferences or behavior analysis, the application shows the user a virtual tour along the path. [12]

In order to present the VR experience on the mobile device the user currently possesses, Scylax collaborates with the device's gyroscope sensor. It will perceive the movements and rotation of the device, and request the necessary images from the RESTful service.

Since VR image sets and videos are tagged with their respective locations, the corresponding VR images/videos can be retrieved when a tour is generated or a precise location is selected. The user can navigate through these VR images and videos to experience the location(s) before the actual visit. [13]

VR experience tools that are currently available, such as Google cardboard, can be used with the mobile device to view VR content. Furthermore, the API server interacts with Google Maps® API (Street View® API) to retrieve and publish images for Scylax. Fig. 6 shows the evidence of how Scylax gives the Virtual Reality 360 ° view experience via a VR box.

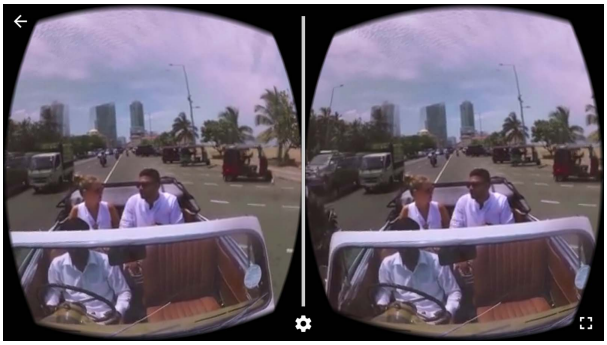

Fig. 6. VR 360° view experience

E. *Scylax API implementation*

Scylax has implemented its own python API for the backend. API makes it easier to develop a program by providing all the building blocks, which are then put together by the programmer. Both mobile application and the web applications are connected via a RESTful interface to connect with the API server which provides services for those applications. API server acts as the brain of the system. It interacts with Facebook API and Google Location API and Google direction API to gather data. The Mongo DB has been used to build the database and it acts as the main storage of the

Scylax. Python API will act as the intermediate interface between the database and the application.

The Scylax backend API has been implemented with a web framework called Flask. The Flask is a micro web framework written in Python and based on the Werkzeug toolkit and Jinja2 template engine, and it does not require particular tools or libraries.

F. Web-based dashboard for business organizations

Scylax provides this separate web-based dashboard for the business organizations to maintain their dashboard and provide their service and offers to the user. Furthermore, a business organization can advertise their organization via the mobile application, by maintaining adverts in the dashboard. In return, these organizations will get seasonal suggestions, and the business analytics to improve their business. Fig. 7 explains the implementation process of the web-based dashboard.

Data plays a crucial part in taking business decisions. This component takes input from many components of the mobile application as well as the web application and analyses them to give a better competitive advantage to business organizations registered with the application [14]. Analyzing the user behavior with the system, the application will suggest businesses about upcoming seasons, and how users have reacted to them in the past. This will also introduce potential clients to the businesses. In addition to that, business organizations get the opportunity to deliver their offers directly to the user by maintaining the offers and services via the dashboard.

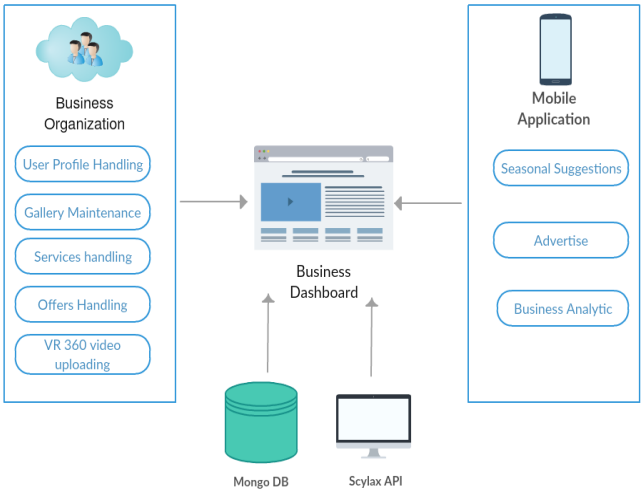

Fig. 7. Web-based dashboard implementation process

IV. Results and Discussion

The results of this research show that Semantic matching, along with the mobility features can be successfully used in implementing the user-oriented tour planning application.

Other than the personalized itineraries, Scylax will allow users to choose the accommodations, and customize the route according to planned number of days and number of people. Finally, as shown in Fig. 8 the application will provide the tour summary with the calculated budget for the whole tour, by taking the transportation method and the accommodation into consideration. Furthermore, the tour best path and the alternative paths will be provided on a daily basis.

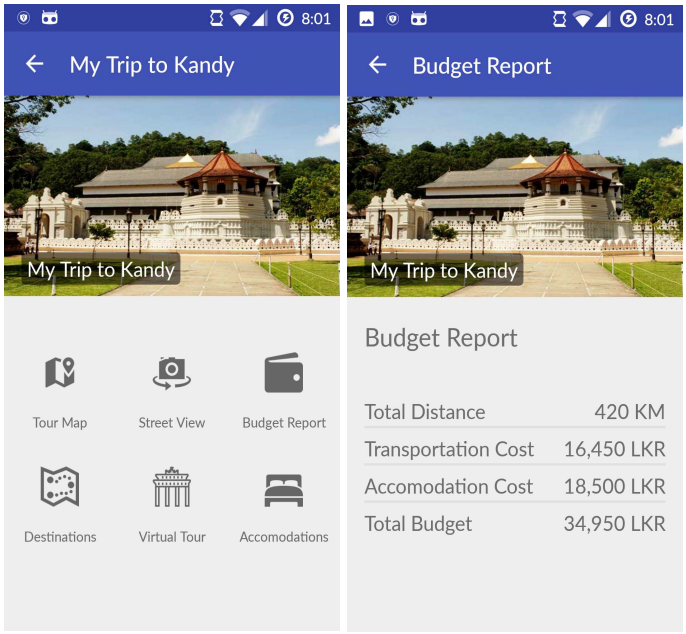

Fig. 8. Tour summary and budget plan

In Virtual Reality, the main focus was to offer the users a VR experience from viewing 360° videos since none of the existing travel-assisting applications provide such luxury. Although at the time the research was commenced, there were no SDKs or materials available to play a 360° video on a mobile device, much less to manipulate. Consequently, the main objective at the time was to find a solid method to handle VR content with a mobile.

Another fact is Mahout uses Pearson Correlation and log likelihood similarity algorithms in user-based and destination based collaborative filtering. The recommender finally capable of suggesting the proper destinations and the pre-planned tour according to the user preferences.

Another fact which is needed to be considered is most of the existing applications have the problem of integrating heterogeneous travelling information, such as accommodations, and business services because no vendors provide their APIs or services free of charge. Scylax has resolved that major issue by introducing its own business dashboard for the organization.

Since Scylax has implemented its own API, the service layer modifications can be easily handled. Even the database schema can be easily changed since it has used Mongo DB for the implementation of the database. The other fact that needs attention, is improving the authenticity of the data in the destinations profiles of the system.

The Scylax consists of two applications, the mobile application, and the web application. Both applications have been implemented on top of Linux environment which is a free and open source environment. Also, most of the tools and technologies that are used to develop Scylax are free and open source. This will be an important fact when considering the development cost since it maintained at a minimum because of the use of aforementioned technologies and tools. But the manpower and the technical knowledge was highly appreciated in the implementation phase.

The application has been tested with several user groups with different kind of travel interests such as cultural explorers, business travelers, wildlife enthusiasts, history buffs and etc. Then the application has given inputs that suit for their preferences to see whether the application responds as expected.

V. Conclusion and Future work

Scylax is preferences and behavior based personalized tour planner which allows travelers to spend quality time planning a tour, without wasting their energy in finding proper guides. Using the proposed application, users will be able to plan personalized tour plans according to their preferences, budget, the number of people, travelling method and accommodation. In addition, travelers will have the opportunity of getting seasonal and behavior-based recommendations depending on their preferences.

The most innovative part of Scylax is, the users are capable of getting a real feeling of the planned tour or the destination before visiting the actual place, via Virtual Reality 360° view. Users can also explore the routes suggested by the application along with the major stops or attractions in the form of a virtual tour. This will help travelers to the desired choice of what they really want to see rather than taking them into what the application wants them to see and wasting their time on experiments.

Not only for travelers, Scylax also provides business organizations several advantages: maintain their services, offers and obtain business analytic based improvements. Additionally, they get the opportunity to advertise and promote their business via Scylax.

As the future works Scylax will be Implementing the tour sharing feature in order to share the planned tours among the followers. The development team of Scylax still works further in fine-tuning the algorithms and techniques to give its users a much better user experience that they have never witnessed before.

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