Web Intelligence in Tourism: User Experience Design and Recommender System

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ABSTRACT

Southland tourism industry is flourishing and has benefited from a wide range of markets. Increasing visitor numbers, coupled with welcoming host communities, has driven tourism to become an important industry in Southland region's economy, however, the amount of tourists and travel information existing on the Internet is overwhelming and bewildering for most visitors. This research describes the creation of a recommendation system that can help tourists visiting Southland region of New Zealand to find tourist attractions and events that suit their preferences and also to promote Southland tourism industry via latest web technology. The main component of the system is a web application that is built using artificial intelligence techniques and methodologies related to web development and recommendation systems. The application will be assessed for the relevance of results to the user, ease of use of the application, and smart recommendation to match user preferences with the tourist attractions and events in Southland.

Keywords: Web Intelligence, Recommender System, Fuzzy Logic.

1. INTRODUCTION

Tourism is a big part of New Zealand's economy. In 2017 total number of tourists visiting New Zealand grew 7% to 3.7 million (Key Tourism Statistics, 2018). New Zealand is blessed with beautiful scenic views. Many tourists tend to visit big tourist cities like Auckland, Wellington, Queenstown and Christchurch. But there is a plethora of places in New Zealand that are less known to wider tourist community but are worth visiting.

When tourists come to a new place, they tend to do a generic search on Google to find places of interest. Google returns a generic list of places, which are not targeted to the user's personal preferences, visiting time and taste. The same happens when the tourists' search on internet for visiting places in Southland. They are provided with a generic list of places that they can visit, which is not tailored to the tourist's personal preferences and likes. Due to this, many places that are worth visiting are left out by the tourists.

This application targets to fill this gap. The application is a hybrid recommendation system that would use the methodologies like fuzzy logic, data mining, and content based filtering to create profiles of the users. Then based on the information provided, and comparison with other similar profiles, and based on the data present in the database related to places to visit, events occurring during the visiting time a list of places and major events or functions will be generated that are tailored specially for the user's personal preference. The users will then be presented with a list of places and events through a web application that the user can access from phone or computer.

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2. RELATED WORK

A recommender system (RS) is a specific kind of adaptive information filter. It is a technique, which tries to provide the user the information he is interested in. The central core of a RS is the term "personalization". The goal of the personalization is to provide users what they need without explicitly asking for it. The system can infer what the user demands not only according to the information that he initially provides, but also by comparing his profile with others users with a similar one (Gahegan, 1999).

The personalizing process is divided into three stages:

- Compiling user information: This stage compiles information about users in order to know them better. This information is stored in separate user profiles.
- Recommending items: This stage offers user the items based on the knowledge that the system has acquired.
- Satisfaction degree: This stage is responsible for measuring the impact of personalization with user's opinion on the recommended items. This step is used as a feedback of the first one, since it takes user opinion into account and so, the system knows him better (Ciurana, 2012).

The number of users who use the web has increased many folds in the last decade. This has resulted in exponent increase in the amount of information on web about everything. All this information may be particularly useful to people who plan to visit a destination that they have not visited in the past. Information about tourist destinations and their associated resources is commonly searched by tourists in order to plan a trip. The list of possibilities offered by generic search on google may be overwhelming for the tourists though.

The first recommender systems appeared in the 90s. The first RS was Tapestry, which used the term "collaborative filtering" for the first time (Goldberg, Nicholas, & Ferry, 1992). Now there are lots of web services that use Recommendation Systems to customize information, such as Amazon, Audioscrobbler of Last.fm, Like-i-Like, MovieLens (RS of

cinema), MyStrands, Photoree , IMDB among others (Porter, 2006).

SPETA (García et al., 2010) uses four steps to generate recommendations. First, it uses contextual information, such as location and time, to generate initial recommendations. Second, a finer grained group of results is calculated using content-based filtering systems. Third, collaborative approach is used to further refine the results. And at last, a vector of preferences is generated, that is used to make final recommendation. Another application, (Braunhofer et al. 2014), uses collaborative filtering with demographic based filtering in the training phase. Once the system has been completely trained, then content-based filtering is applied to generate recommendations. Content-based filtering computes ratings for each item based on the current values and predicted values.

SigTur (Borràs et al., 2011) used Integrated use method were both collaborative and content based techniques are applied in conjunction with each other to generate recommendations. Different ratings are calculated to estimate the interest of a user in an activity. Ratings are calculated using demographic clustering, collaborative clustering and content based clustering. In the end, the ratings generated by each method are combined together to finalize the recommendations. In (Lucas et al., 2013) the users are classified in groups based on demographic data, on information related to past preferences of the user (Content based), and based on information to preferences of similar users (collaborative approach). Then a set of fuzzy rules is generated so that classify the users into various groups. At the end final recommendations are generated based on this.

Recently, there has not been a lot of research in the field of tourist recommendation systems in New Zealand. A mobile application related to tourist recommendation system was developed by Hinze and Junmanee (2005). Hence, this research provides a good opportunity to explore the use of this technology in Southland, New Zealand and to encourage more researchers to investigate the use of web intelligence in different aspects of southland economy.

A feature common in the vast majority of recommender systems is the use of profiles that represent the needs of information and interests of the users. In this way, users' profiles turn into a key piece of recommender systems in order to obtain an efficient filtering. An inadequate profile modelling can lead to poor quality and little relevant recommendations for the users.

Finally the majority of tourist recommender systems tend to suggest attractions to the tourists once the tourist has reached the destination, or at least decided where they are going. The complexity of such systems is overwhelming, as they have to filter out the recommendations that are only interested to the tourist. The filtering is performed on a huge list of other options. Tourists use these sort of applications to find places of interests. Many of the applications filter information present in a static database. But there are some applications, Otium (Montejo-Ráez et al., 2011) as an example, which extract information directly from the web. This ensures that the application always get the updated information. Such applications use public web APIs to get updated information

3. TECHNIQUES AND COMPONENTS

The application will make extensive use of fuzzy logic, content based filtering, collaborative filtering, association rule filtering and hybrid filtering. An introduction to these components is given in the following section.

3.1 Fuzzy Logic

Fuzzy Logic (FL) is a method of reasoning that resembles human reasoning. The approach of FL imitates the way of decision making in humans that involves all intermediate possibilities between digital values YES and NO (Artificial Intelligence - Fuzzy Logic Systems, n.d.).

The conventional logic block that a computer can understand takes precise input and produces a definite output as TRUE or FALSE, which is equivalent to human's YES or NO (Artificial Intelligence - Fuzzy Logic Systems, n.d.).

3.2 Categories of Recommender systems:

Recommender systems are typically categorized based on the filtering techniques they use. These are:

1. Content based filtering:
2. Collaborative filtering.
3. Association rule filtering.
4. Hybrid filtering

3.2.1 Content based filtering

Content based filtering relates to finding products with similar attributes. As an example if a user likes Lord of the rings. Lord of the rings has ratings against various attributes, like cinematography, direction, music etc. We can suggest the user another movie has similar ratings against these attributes.

3.2.2 Collaborative filtering

Collaborative filtering relates to suggesting items liked by similar users. As an example if UserA likes Hobbit, lord of the rings, and cast away. And UserB likes hobbit and lord of the rings. Then we can suggest cast away to UserB, because he has given similar ratings to the movies as UserA.

3.2.3 Association rule filtering

Association rule filtering relates to suggesting items that the user is more likely to have together. As an example, if a person buys a smartphone, suggest him to buy a pair of headphones too.

3.2.4 Hybrid filtering

Hybrid filtering combines two or more filtering methods. They can be combined in a sequential order or in integrated fashion. In sequential approach, each recommendation technique is used in different stages of user interaction. In integrated approach, two or more filtering methods are applied together to find the final result of recommendations.

4. METHODOLOGY

The application's heart, will be the core engine based on content based filtering and collaborative filtering that generates recommendations will be created using C#. The web interface that the user will use to interact with the system will be built using ASP.NET MVC 5, using C# as the programming language.

The representation of the geographical resources in the maps of the web interface has been designed with Google Maps API. Google Maps API will allow us to create integrated maps in the application, and also allow us to use other services such as Street View, the geocoding and the calculation of itineraries to from one place to another. The database that will be used to store all the information will be Microsoft's SQL server. Connections between the databases and the MVC framework will be handled by Entity Framework 6. Data related to the places and what's going on or latest events or functions will be collected from Tourism Southland website, various i-Centres across Southland, from Google places database and from Trip

Advisor. Google places databases and Trip Advisor databases will be accessed using the public APIs that both Google and TripAdvisor provide.

Leisure activities will consist of various labels like beaches, theme parks, spa centres, shopping areas, nightlife areas. Sports will have labels like aquatic sports, and non-aquatic sports, adventure sports. Culture will include labels related to places of historic significance, and museums. The group nature contains natural spaces and recreational areas. Routes consists of walking routes, biking routes, and driving routes. Food consists of fine dining, fast food, liquor and coffee. Events would consist of labels related to outdoor events, and indoor events.

The application will keep track of four kinds of information:

- Destination tags database, which will keep track of tags that each destination pertains to. For example, a café would pertain to food, gastronomy, coffee tags.
- The user rating database, which will keep track of ratings of travel destinations.
- The user profile database, which will store general information for the user, like login information, demographic data, age, and explicitly stated interests.
- The events or tourism function in the targeted destination, which will be stored together with the destination tags database.

5. SYSTEM OVERVIEW

For the purpose of this research we have designed and implemented a recommender system that helps to generate recommendations which can be finalised by the user, all the destinations will be shown on a map, geo location data (latitude and longitude) of the destinations will also be required, which will be obtained with the help of Google Maps API also a set of events and tourism functions in the desired destination will be recommended to the user.

Step 1: The user will be greeted by a welcoming page (Figure1) then after accessing the system they have to answer a few questions to enable the intelligent mechanism to construct their specific profile, several questions will be provided such as age group, number of members in the trip, number of children in the group, country of origin and etc.

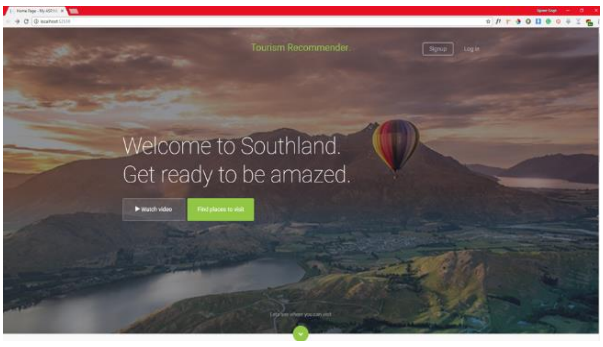

Figure 1 welcome screen

Step 2: After that the user will be provided with a list of items that they might be interested in. These items will include going to the beach, going shopping, relaxing, amusement parks, culture, nature, gastronomy, sports, shows and events, partying and etc. The user will be asked to rank all these items based on their priority. For example, a middle aged user may give more priority relaxing, beach, culture, events and etc. Whereas a young couple might give more priority to partying, shopping, sports, amusement parks etc. The user then has to rank these priorities on the scale of 1 to 10. 1 means low priority and 10 means high priority.

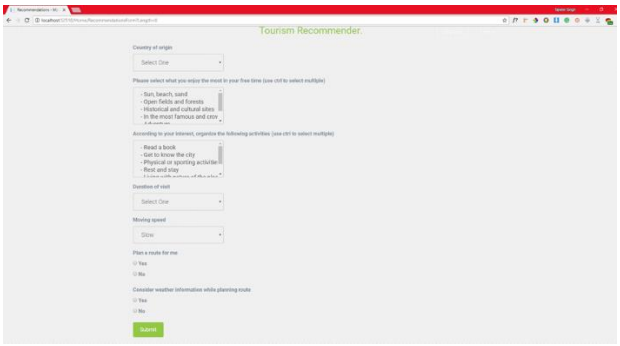

Figure 2: Fuzzy engine

Step 3: Based on the selections by the user, a degree of confidence will be calculated and confidence value will be assigned to the above mentioned seven activities. Then these values of confidence will feed into the Fuzzy engine (figure2).

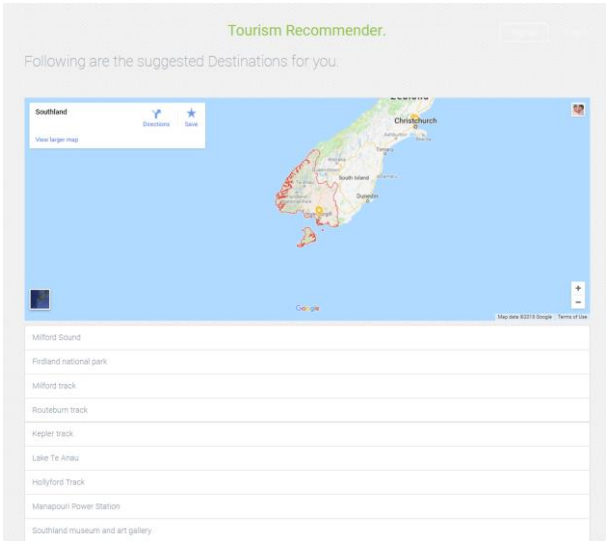

Figure 3; suggested places

Step 4: Based on the output by Fuzzy engine, the user will be suggested sub categories. For example, if the user has chosen food or gastronomy, then the user will be presented with further options in gastronomy category, like traditional food, fast food, fine dine, coffee bars, liquor bars and etc. The user will be asked to select items from the list.

Step 5: Then based on the selected items the system will then suggest a list of number of places or events to visit (Figure 3).

Step 6: If the user is satisfied, then a complete map and route of places that the user can visit will be generated. The map will be generated using Dijkastra's shortest path algorithm. If the user has selected any events, then a calendar will be generated for the user. There will also be an option for adding the events in the user's personal calendar.

Step 7: The user will be constantly asked to give feedback about the places that they have visited. The user will be asked to rank their experience on the scale of 1 to 10. The feedback can consist of various questions like ease of access, quality of service, overall experience etc. this feedback can be used in future to provide better recommendations for other users too.

Step 8: The system will also give the user an option to register the generated data into their phone for live tracking. For this

the third-party OAuth Google login system will be used. This mean that no user data will be saved locally, hence satisfying the ethical issue of not storing personal data locally.

The system will analyses and track all the user actions in order to improve the adequacy of the recommendations, both for current and future users.

6. CONCLUSION

This research paper has illustrated the main characteristics and design of a proposed recommender system to promote tourism in Southland. Recommendation systems are everywhere. They are used by every large online tourism corporation to increase the profits by tailoring the recommended products to the users in which they will be interested in. Southland's economy can also benefit from this technology with the help of this application, which will help tourists to find and visit places that are targeted to their personal preferences and needs. The research can be helpful to design recommendation systems for other aspects of economy which rely heavily on online users for daily business activities. Further research will be undertaken in the areas of soft computing for recommender systems to ensure that the proposed solutions are the most appropriate and to increase recommendations efficiency. The proposed system will undergo further development, refinement and evaluation and finally user acceptance testing will be performed to tune the final result. The majority of contextual factors are specified at this stage. However, time and personalisation (user profiling) require more work to effectively use these contexts in the proposed intelligent model.

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