Automatic User Profiling for Intelligent Tourist Trip Personalisation

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Abstract—**lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.**

Index Terms—**tourism,itinerary, user-profiling.**

I. INTRODUCTION

A. Problem Definition

Producing an itinerary before a trip can be a demanding task which requires a substantial amount of research. Many times people rely on travel books, individual travel blogs and online websites to form a holiday plan, but these are not always tailored according to the traveller's preferences and opinions [1].

This paper focuses on creating a system which helps tourists automate the process of travel planning. An adequate automated trip planner application would consist of two parts,

1) the retrieval of user preferences
2) the generation of a custom itinerary

Numerous systems, which will be discussed in the Literature Review, are available and therefore building a working prototype is both possible and feasible Although these systems automate the process of producing the itinerary, they require a lot of end-user data and preferences to form a personalised itinerary. Can the user preference gathering be automated?

Given the amount of information a single user holds online, it is possible to automate and help the process of gathering personal preferences [2]. A deep learning model could be trained to classify a person's social media profile to determine what the user wants from a trip. This information alongside other parameters such as the user's budget and trip length could give out a very accurate personalised holiday plan.

B. Motivation

The immense amount of data generated by each user online [3] was the main motivation behind using this advantage in creating a unique system that benefits tourists by implementing something easy to use and does not bombard them with a lot of extra questions. Although planning itineraries can be a complex problem [4], if the users allows the system to gather preferences based on their social media profile, preferences can be collected automatically based on his posts.

C. Why the Problem is non-trivial

User Profiling based on social media has been an essential part of Personalized advertising. The advertisers can target their customers more accurately and earn more sales per viewer [5]. However, this paper aims in using such a technology to implement a different approach in automating the preference gathering.

D. Aims and Objectives

The aim of this project is to quickly generate a personalised itinerary by making use of preferences and parameters.

This system will aim to achieve the following Objectives:

1) Collect social media images to form a training and testing set which will be categoriesd by the activity. These can include images associated with events such as, nature, beach, sports, food, bars and clubs.
2) Design a model that classifies the images correctly.
3) Define a user profile based on the social media collection results and additional parameters.
4) Gather a list of places available and form scores for each activity based the user's parameters.
5) Generate quickly multiple itineraries each with different score levels.

II. BACKGROUND RESEARCH AND LITERATURE REVIEW

Several studies both on user profiling and on real-time automatic trip itinerary generation have been carried out throughout the years.

There are many types of systems which help the travellers in their trips. Gavalas et al. [6] categorised these into **POI recommenders, Tourist Service Recommenders, Collaborative content from users and social media services, path recommenders** and **Personlised multiple-day tour planners**. The planning of a trip to a traveller introduces the Tourist Trip Design Problem (TTDP) which has recieved a lot of observation and heuristic contribution [7], [8]. Sylejmani et al. [9] have defined the TTDP as part of the Orienteering Problem(OP). OP problems contain a number of nodes each containing a score and try to solve the path containing the maximal score constrained with parameters such as time and budget [7]. Gunawan et al. [7] state that OP is a combination of

the Knapsack problem and the Travelling Salesman Problem (TSP). There are many solutions to this problem which will be discussed in the next section.

A. Tourist Recommender Systems

In 2004, a paper by Dunstall et al. [4] was published using a prototype called the The Electronic Travel Planner (ETP). This system selects destinations by determining activities based on the user's preferences. Each activity is stored in a relational database with information such as duration, availability, date and time categorised as either tours, lodging or transportation. The requirements for forming such an itinerary include the number of children and adults, the location, the date range, budget and user preferences in the form of *mandatory, at least once, desired, forbidden and permitted* activities. Since examples given in the paper took 15-45 seconds to process the resulting running time was listed as an issue.

The Recommender System (RS) was provided by Sebatsia et al. [10] and Garcia et al. [11] to suggest tourist locations. User preferences are collected in the form of age, gender, nationality and ontology. The recommender is based on 5 techniques, *Demographic recommendation, collaborative recommendation, content based recommendation and knowledge based recommendation.*

A different approach using social media was presented by Choudhury et al. [1] in 2010 and Brilhante et al. [12]. Geo-referenced Flickr [1] content alongside Wikipedia [2] information was used to gather information such as the date, location and popularity of the photos being uploaded. An OP algorithm was then used to generate the ideal number of Point of Interests (POI).

A tabu Search approach was proposed by Sylejmani et al. [13] as a Multi Constrained Team Orienteering Problem with Time Windows (**MCTOPTW**), an advanced form of the OP.In this algorithm, three steps were used in order to generate the activity plan. A new activity is added as a node to the trip using *Insert*, A node is exchanged with a new activity using *Replace* and two nodes are swapped using *Swap*. A pair of tabu lists structured frequently are used to avoid repeating solutions.

Recently, a solution towards presenting an itinerary solving conflicts between multiple tourists with different preferences by creating a group recommender system (GRS) [8], [14] was proposed by [9]. All tourists are split into groups by preference, during certain activities the itinerary splits up the groups to visit their specific POI. Before the trip one of the options is selected:

1) **Solo**: A trip for a single person.
2) **Subgroups**: The tourists are separated into smaller groups by preference and travel together.
3) **All Together**: One itinerary for all Tourists.
4) **Tourists Combined**: At certain times, tourists are separated to meet their personal preferences

An unique approach towards collecting the group's preferences for a GRS is offered by Nguyen et al. [15] An android

[1] https://www.flickr.com/
[2] https://www.wikipedia.org/

group chat application called STSGroup was created to target conflicts between tourists. The idea is to collect the users' preferences when they are communicating with each other rather than individually. An example of a group of students travelling to South Tylrol (Italy) was given in the paper in which each person described its profile using certain tags such as the mood or parts of groups they form of. Upon the text conversation users send a selected POI in which other users can give it a thumbs up or down. Ranking lists and logistics are calculated in the background based on the group chat's data collection to determine the ideal preferences for the group.

Iterated Local Search could be used to generate the travel itineraries as seen vansteenwegen et al 2009 [16]. This approach is considered to be very suitable for real-time TTDP applications [17]. This approach finds a solution using the the best generated outputs from local search and repeats the procedure until a desired score is reached. In 2011, CityPlanner3 [18] integrated ILS with Greedy Randomised adaptive search Procedure (GRASP) [19]. This system allowed to alter POI durations and choose a starting and ending point.

B. User Profiling for Travel Preferences

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