Travel Direction Recommendation Model Using User Social Network Profile Photos

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ABSTRACT_ Travelling is one of the most enjoyable activities for people of all ages. It is constantly looking for innovative solutions on how to tailor travel recommendations to the needs of its customers. The purpose of our proposed recommendation model is to suggest travelling countries based on photos from the user's social network account and metadata associated with the photos. Such recommendation models are highly dependent on the data used in the model preparation steps and on the technologies and methods implemented in the model. The newly collected data from the Instagram users' accounts were used in the model preparation. The recommendation system is based on the combination of four methods: object detection, similarity measures, classification, and data clustering. The novelty of the proposed recommendation model is that it adopts different data (Instagram photos) for travel direction recommendation, defines a new combined method, integrates results of similarity measurement and SOM application results into one final recommendation, and estimates the parameter impact for different components of recommendation model.A proposed evaluation measure has been used to conclude the results of the recommendation model and as a result the names of the travelling countries have been recommended. The results of the proposed recommendation model are promising, and the validation results demonstrate that on average 63% of the users who visited countries match the recommendations provided for the trip directions, while the accuracy of recommendations, matching user visited countries, but not presented in the photos for recommendation estimation, on average was 96%. The accuracy performance is very positive, while the recommendation system is fully automated and machine learning based. With time, the accuracy of the model may even increase by adopting the photo metadata (location).

1.INTRODUCTION

According to various statistical studies around the world, many people missed out on travelling during the pandemic situation. Therefore, when the situation of COVID improves and various restrictions have disappeared, people start to travel again. It is one of the activities that people like the most at different ages, so for business it is not only a lucrative field but also a competitive market. Therefore, to increase the success of travel operators in finding potential customers, The associate editor coordinating the review of this manuscript and approving it for publication was Alberto Cano.

targeted advertising is very effective. This happens because a potential user is automatically selected for a trip that may be of interest to him. Predicting the most accurate travel destination for a particular user can be difficult. However, research has shown that there are similarities between user groups that determine what type of

travel a user group may like . Nonetheless, to implement a recommendation system qualitatively, the data used for such a system are crucial. Recommendation systems are widely used in different areas, but travel recommendation systems face the problem of the need and accuracy of labelled data. Although many travel recommendation systems currently rely on data provided by
social networks and other platforms for user hobbies antravel. Some of the systems incorporate data from a wide variety of systems and even smart devices from the Internet of Things. There is always the possibility that the consumer was not impressed or even disappointed with his or her travel, but the data do not show it.
The main advantage of Instagram over other social networks is the predominance of posting photos. Photos are related to hobbies, travel, etc.
Therefore, the analysis of publicly available consumer photos
can provide travel agencies with the necessary information to enable them to offer the appropriate type of travel to the
consumer. The fact that photos reflect the user's opinion rather than the responses to questionnaires or even similarities with other users is also observed in the research by Linaza et al.
The main objective of this article is to reduce uncertainty to the extent that modern data analysis methods, such as data classification and clustering, are appropriate for recommending different types of travel to users based on photos publishe on their social networks. The goal of the experimental investigation would be to examine existing solutions, compare them with each other, and propose the most promising model, adopting different results of the analyzed methods.
The idea of a travel recommendation should be based on the objects identified in the user's Instagram profile photos rather than post metadata only. This potentially will allow travel direction recommendations based on preferred activities, rather than geographical location alone. In practice, such a proposed recommendation model would increase the chances that the travel agency actually chooses at least one of the several trips shown to the consumer. This would meet
his or her needs. As a result, the advertising from the travel agency would be used more purposefully, and the consumer would receive a set of travel offers that better meet his expectations. Furthermore, the consumer's satisfaction with the experience would increase accordingly.

2.LITERATURE SURVEY

2.1 Tell me who you are and I will tell you where to go: Use of travel personalities in destination recommendation systems.

Current efforts in destination recommendation systems research and design are based on the assump- tion that user preferences have to be captured in the most accurate way possible to be able to provide useful recommendations. However, leading the user through a series of mind-puzzling diagnostic questions is often cumbersome and, therefore, discourages use. This article explores travel personal-ity categories as a possible shortcut to classifying users. The results of this study suggest that travel personality types selected by the survey respondents can, indeed, be matched up with certain travel behaviors. Implications for future research as well as systems design are presented.

2.2 Movies recommendation system using collaborative filtering and k-means,

The purpose of this research is to develop a movie recommender system using collaborative filtering technique and K-means. Collaborative filtering is the most successful algorithm in the recommender system's field. A recommender system is an intelligent system that can help a user to come across interesting items. This paper considers the users m (m is the number of users), points in n dimensional space (n is

the number of items) and we present an approach based on user clustering to produce a recommendation for the active user by a new approach. We used k-means clustering algorithm to categorize users based on their interests. We evaluate the traditional collaborative filtering and our approach to compare them. Our results show the proposed algorithm is more accurate than the traditional existing one, besides it is less time consuming than the previous existing methods.

2.3 ‘‘Hotel recommendation system based on review and context information: A collaborative filtering appro.

Due to the increment of different formats of online expressions such as reviews, ratings, and recommendation, it is getting more difficult to identify users’ preferences toward the products. A large number of reviews can be generated and diffused by online users in travel booking websites. A set of Recommendation Systems (RSs) has emerged to help consumers to filter items based on their preferences. The Collaborative Filtering (CF) based approach is one of the most popular techniques of the RS; however, it also suffers from several fundamental problems such as data sparsity, cold start, shortage, and rating bias. This study proposes a context-aware hotel recommendation (CAPH) approach; using the context-aware information to provide personalized hotel recommendation system. This research considers recommending hotels based on the hotel features and traveler’s type. Experimental data is collected from Tripadvior. com during the period of 2015 to 2016. The evaluations of system accuracy will be conducted and then compared with the user-based/item-based CF model.

2.4 A content-based goods image recommendation system.

The information of e-commerce images varies and different users may focus on different contents of the same image for different purpose. So the research on recommendation by computers is becoming more and more important. But retrieval based only on keywords obviously falls short for massive numbers of resource images. In this paper, we focus on a recommendation system of goods images based on image content. Goods images have a relatively homogenous background and have a wide range of applications. The recommendation consists of three stages. First, the image is pre-processed by removing the background. Second, a weighted representation model is proposed to represent the image. The separated features are extracted and normalized, and then the weights of each feature are computed based on the samples browsed by the users. Third, a feature indexing scheme is put forward based on the proposed representation. A binary-tree is used for the indexing, and a binary-tree updating algorithm is also given. Finally, the recommended images are given by a features combination searching scheme. Experimental results on a real goods image database show that our algorithm can achieve high accuracy in recommending similar goods images with high speed.

2.5 A short survey of recommendation technologies in travel and tourism.

Recommendation has a long history as a successful application area of Artificial Intelli- gence. The demand of e-commerce platforms (e.g., amazon.com) to improve the acces- sibility of large product- and service assortments contributed to an increased popularity of recommendation technologies. Three basic technologies supporting the personalized recommendation of products and services are presented in this paper. In order to take into account the focus of this special issue, we provide a discussion of the application of those technologies in the tourism domain (e.g., recommendation of travel

destinations) with a special focus on mobile environments.

2.6 Personalized travel package with multi-point-of-interest recommendation based on crowdsourced user footprints.

Location-based social networks (LBSNs) provide people with an interface to share their locations and write reviews about interesting places of attraction. The shared locations form the crowdsourced digital footprints, in which each user has many connections to many locations, indicating user preference to locations. In this paper, we propose an approach for personalized travel package recommendation to help users make travel plans. The approach utilizes data collected from LBSNs to model users and locations, and it determines users' preferred destinations using collaborative filtering approaches. Recommendations are generated by jointly considering user preference and spatiotemporal constraints. A heuristic search-based travel route planning algorithm was designed to generate travel packages. We developed a prototype system, which obtains users' travel demands from mobile client and generates travel packages containing multiple points of interest and their visiting sequence. Experimental results suggest that the proposed approach shows promise with respect to improving recommendation accuracy and diversity**.**

3. EXISTING SYSTEM

The development of a recommendation system based on users' published photos and recommending a travel destination accordingly requires the interoperability of different technologies and methods. A review of recommendation systems in the field of tourism shows that an increasing proportion of them rely on big data processing and artificial intelligence solutions [15]. Solutions to many existing user based travel recommendation systems are based on finding a specific location on a photo or a specific user found on a photo [16]. However, in our research, we investigated the extent to which photographs depict common objects, such as animals, notes, food, and more. This is because photographs may reflect the user's profile and interface with the country of interest to the user. Today, the problem of object detection in photographs is also a highly analyzed field. The main key is to

provide a list of recognized objects and the probability of their identification [17]. Having a list of objects that have been detected in the photo, the list could be used in classification tasks. This list could be used to determine a country similar to the data item. The object detection results are influenced by various factors, such as the algorithm selected and the way in which it has been trained.

Scientific literature analysis showed that there is no publicly available dataset that could be used to prepare a recommendation model based on objects detected in the images. Usually, all datasets are focused on different aspects and therefore aren't applicable. Compiling a dataset and preparing the data for research is not a trivial task. This is because the accuracy of modern artificial intelligence solutions is highly dependent on the data used for training and their preparation. Sometimes, including too much context in a decision does not increase the accuracy of the decision but reduces it [18]. Therefore, it is necessary to find a balance between the completeness of the data and redundancy. The classification of multiple levels in travel recommendation systems helps to solve the problem of data redundancy [19]. This problem is often due to the very high integration of different data sources [20], but it is also possible in the object detection field, where the objects depicted in the photos may be too specific to be identified (for example, a specific dish is identified rather than simply a category of food). In addition to multilevel classifiers, a knowledge graph base [21] and interfaces

between objects the analyzed are also developed.

In many scientific studies, recommendation systems employ well-known methods. One of the old but often used techniques is calculating the similarity distance between vectors. There are a variety of similarity measures. Effectiveness is trusted and can be used when pair-wise similarity has to be determined, but new heuristic measures are emerging. In the manuscript by Ali et al. , the performance of three newly formulated similarity measures, namely the difference-based similarity measure, the hybrid difference-based similarity measure, and the triangle-based cosine measure, has been investigated. There is more research in which novel measures are proposed and analyzed . Based on the obtained results, it can be concluded that the efficiency of the newly proposed measures does not differ significantly from traditional similarity measures. These measures are usually used for specific tasks. The various classification and clustering algorithms are usually combined with the similarity distance results to develop the recommendation model. The support vector machine, decision trees, random forests, or even deep learning algorithms, like long short-term memory are examples of traditional classification algorithms. There are also many data clustering algorithms, but the most commonly used are K-means, hierarchical clustering, and K-nearest neighbour. It is obvious that there are many different combinations of how these types of methods can be combined to obtain a high accuracy recommendation.

4. PROPOSED SYSTEM

In this paper, a recommendation model based on a combination of supervised and unsupervised methods results has been proposed. First, Instagram user data has been collected and pre-processed using Microsoft Azure to identify objects in photos [14]. The final pre-processed data consist of 4683 attributes, where four attributes are metadata and the rest are object detection in the photos results. The data collected will be used in the future to train some components of the recommendation model. These components will be able to identify countries that users have already visited and suggest new countries to visit. When the data item fed to the recommendation model does not have any metadata or the visited country list has not been determined, similarity distance and self-organizing maps have been applied to identify possible countries based on object detection results. The results of the proposed model have been concluded by combining the results of similarity distance and clustering into a final recommendation model. The model incorporates different aspects of the similarity distance and clustering results to determine the final travel destination recommendation list based on the user's previous travelling photos.Amore detailed description of the proposed recommendation model

is presented in the proposed system.The novelty of the proposed recommendation model is that it is fully automated and does not require any manual changes.

Artificial intelligence methods allow us to retrain the model over time, improving its accuracy. Unlike most other recommended models, the recommendation is performed by extracting data from photos, and if appropriate, the metadata of each photo has been included and analyzed too. Such input data for travel direction, country recommendation was not presented before. The scientific novelty of the manuscript is the combination of a few well-known methods to perform recommendations using not only the well-known similarity distance, but also self-organizing maps. Usually, the self organizing maps are used to cluster or visualize the data in a general form, but going deeper into the structure of the self-organizing maps the neighbouring rank can be modified and adapted to find out the most related data items in the self-organizing maps. In this manuscript, we modified and adapted the usage of

neighbouring rank in the self-organizing map cell by combining it with similarity measures to find the most similar data item to the new data item fed into the model. In this way, the countries' recommendations are provided. In addition, self-organizing maps have difficulties in performance using high-dimensional data, so they have been combined with dimensionality-reduced methods. The proposed evaluation measure allows to summarize the results obtained with all methods and to provide a travel recommendation. The proposed recommendation model can be beneficial to businesses and can be easily implemented on websites and customised.

5. RECOMMENDATION MODEL

A. Dataset Used in Model Preparation

Any recommendation model must be prepared and trained using historical data (in the model, is marked as Historical data). So, first, the Instagram users' profiles that have agreed to share their traveling photos have been web-scraped. The criteria for user selection were:

1) to have at least 10 photos taken during travel;
2) for at least half of the photos to define the country where the photo was taken (done by the user or by estimating photo metadata or text description);
3) user to participate in the research and define how he or she evaluates the recommendation.

B. Metadata Analysis

The described dataset has been used in three parts of the proposed recommendation model:

1) the metadata used to train the classifier;
2) to calculate similarity distance between new data items fed to the model and historical data items, to determine the most similar TOP 10 countries names in the dataset;
3) to train the self-organizing maps.

To determine which similarity distance measure and classifier are the most suitable, fits in the proposed recommendation model, the dataset has been split into 5 parts for the cross-validation method.

C. Similarity Distances

The related work showed that there are many different similarity distance measures that could be used to find out how one data item is similar to the rest of the dataset items. In this paper, we have been analyzing the effectiveness of several commonly used similarity distances using our newly collected data. Most of the chosen similarity distances have been used and analyzed in overviewed related work recommendation systems, so it is important to investigate the performance of them in our proposed model, too.

6. DISCUSSION

Validation of the proposed travel recommendation model has been performed using a small amount of data collected from real people and their travel experience data to simulate a real situation in the model. To validate the model, the artificially made dataset could be used instead of the real people's data, with a larger amount, but in that case it will distort the real situation. All parts of the model have been tested in the model development process, so there is no reason to test the final travel recommendation model proposed on the large dataset. This proposed model will be used in the real information system, and the collected user experience data will be take into account in the future for a deeper analysis. Comparison to other travel recommendation models is very limited. None of them use the same test cases or input data, Instagram photos. For example, Xiang Huang proposes a place of interest text description and user comment comparison-based travel recommendation system. The model is able to achieve up to 88% recommendation accuracy and

outperform existing analogue solutions [47]. Considering text descriptions are more representative of user opinions than photos on Instagram, our results are in the same range – we achieved 66% accuracy for all user visited locations, and 96% accuracy for recommending countries not shown in the input photos.

7. CONCLUSION

In existing research articles, the recommendation of travel destinations is still relevant, but there is a lack of datasets for visited countries, locations, travel photos and objects in them. We designed a fully automated solution that gathered user Instagram photos, detected objects in the photos, and analyzed the item data to improve location accuracy. Automating this process enables us to create a data set of needed data and adjust or discretize its metadata. In the context of the collected dataset, user photos can be analyzed and compared with the records in the dataset, calculating their similarity and membership of the cluster. By combining county data with similar photos, we can build a travel destination recommendation system. As a result of the experiments conducted, it can be concluded that different variation in the model is capable of improving accuracy.

However, the most effective result is achieved by using a combination model, which is able to recommend ten countries, which corresponds to 63% of the countries the user visited. We found that accuracy was even higher, on average 96%, when we analyzed how many countries users travelled to in addition to those provided as input for the model. Based on only user photos, this is a promising result to predict travel directions more accurately.

Our proposed travel recommendation model is based on the comparison of the detected object vector with other records in our dataset. This eliminates the need for repetitive analysis of each photo. But at the same time, it becomes very sensitive to changes in the object detection model. Because of this, our dataset was not able to be used for analyzing photos processed with different object detection solutions.

These solutions provide different lists of detected objects or different distributions of the probability of detecting an object. In case of object detection model changes, the whole dataset of compared photos should be revised to get updated scores of detected objects.

The current solution is designed to recommend countries. Since some countries have a wide variety of regions, the model could be updated or expanded to recommend a more specific location. This could be a region or even a specific area. The data is available in the dataset and could be used for more detailed travel planning.

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