Advanced Tourist Trip Planning Using Hybrid Recommender

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Abstract

The paper intends to underline that tourists' and travelers' behaviour and preferences have changed dramatically specifically in the way how they search for information. In order to create a tailor-made itinerary and enhance the way of planning a tourist trip, the paper suggests introduction of tourism recommendation systems. For this purpose, a methodology is proposed that assists all interested parties in planning their vacation in more intelligent and sophisticated way by generating a personalized list of favorable items. By application of this approach, consumers can create custom-made ideal holiday, thus resulting in satisfied tourists with access to various information on prices, distributors, providers and entire market of competitors, and pay for a high quality service.

Keywords

Tourism; Recommendation Systems; Tourist Trip; Planning

Introduction

Based on numerous positive impacts that tourism produces on national economies, each country is interested in enlarging the quantity of tourists and travelers. However, that is not a trouble-free process, particularly in times of ever-changing travel preferences and continuously modifications of consumers' behavior. The Internet as one of the leading source of electronic communication encompasses the services of general economic interest and has major influence on the way consumers approach their rights as the final step of the process. In this line, one may add that the development of services ensures permanent two-fold improvement: on individual, as well as on organizational level (Popescu et al., 2011) Particularly, in the past two decades, by mediation of digital environment, tourists changed their behavior dramatically and gained knowledge regarding their consumers' rights (Mills and Law, 2004). Over the years, tourists transformed themselves from "passive audience" to "active players" (Prahalad and Ramaswamy, 2000). Furthermore, a noteworthy transformation is made from just passive searching and surfing to creating content, collaborating and connecting. Hence, a "new" tourist is developed who is knowledgeable, asks exceptional value for his money and time (Buhalis and Law, 2008) and requires a holiday in protected areas (Minciu et al., 2012). So, each of seventeen type of tourists, is defined according to Gibson and Yiannakis, (2002), as: sun-lover, action-seeker, anthropologist, archeologist, organized mass-tourist, thrill-seeker, explorer, jet-setter, seeker, independent mass-tourist I, independent mass-tourist II, high-tourist, drifter, escapist I, escapist II, sports-lover and educational tourist, has different request. Hence, they differ in various manners and have different preferences, motives and expectations from a holiday. In this respect, they seek different kind of information regarding particular trip or stay, like booking, paying and so forth. Yet, by strong expansion of digital media, tourists face with variety of options regarding tourist destination or attraction. Frequently, they are not in a position to cope with such a huge volume of choice, and need an advice about where to go and what to see. Consequently, one may argue the need for creating an itinerary that will perfectly match tourist's and traveler's expectations. This will decrease or even remove potential disappointment, discomfort and inconvenience which are essential to each consumer. By introduction of tourism recommending systems, tourists may easily access information they need thus resulting in shorter lead-time for bookings, making last-minute decisions and generally, tailoring their own packages from a suite of options. The result will satisfy consumer that has paid for tourist service with high quality, has a full access to various information on prices, distributors, providers and entire market of competitors. So, the tourist will be able to make a tailor-made holiday and to plan it on a more intelligent way. The decisions and choices about when to travel, how to pay, which cities to go to, places to visit, attractions to see, events to participate in, travel plans, road maps, options for hotels or air companies, will entirely be in tourist's mandate.

This study presented and elaborated necessity of introducing recommenders in tourism which may assist tourists in finding a way-out in creating their perfect vacation in efficient and transparent way. In order to meet the forth mentioned aim and objective, the paper was structured in several parts. Section 1 gives a snapshot on tourism recommendation systems. Section 2 presents a brief overview on literature review on this issue. Methodology in terms of recommendation process, algorithm, design and implementation of recommendation systems is set in Section 3. Section 4 indicates the main findings and results, while the conclusions and future research directions are noted in Section 5.

Snapshot on Tourism Recommendation Systems

Surrounded by enormous variety of information, tourist is often confused which information to choose as appropriate. That process usually is time-consuming and money-consuming as well, thus resulting in inefficient decision. The way out is detected in application of recommendation systems as a promising way to differentiate a site from competitors. So, the solution is seen in personalization of information delivery to each tourist or traveler, together with its travel history. Yet, advanced tourist information systems must offer more than just relatively static information about sights and places. Hence, user-generated content gained in significance thus enabling developing more accurate recommendation systems. Consequently, one may add that recommendation systems contribute to facilitating personal selection and prevent tourists and travelers from being overwhelmed by stream of superfluous data unrelated to their interest, location and knowledge of a place.

Having in mind that recommenders are fully based on digital environment, the Internet has influenced tourism in significant manner by providing a great variety of services and products on-line particularly important in times of increased number of competitors in tourism market (Kabassi, 2010). By increasing the importance of search in travelers' access to information, tourist destinations were forced to identify more suitable approach to adapt to the fast-pace ever-present environment changes (Pan et al, 2011). This particularly addresses the on-line tourism supply since tourist destinations have strong need to acquire data for potential and present tourists and travelers.

Nowadays, there are lots of recommendation systems accessible via Internet which attempt to recommend users various products and services. Generally, recommenders are systems which intend to acquire opinions or preferences about items from a community of users, and use those opinions to present other users with items that are of interest to them. So, they are based on: the information about the user's preferences, and a way to determine if an item is interesting for the user (Orio, 2006). The latter depends on the kind of recommendation system, and in applied techniques for finding similarities among items or users. In more details, recommendation systems produce individualized recommendations as output or have the effect of guiding the user in a personalized way to interesting or useful objects. Additionally, one may note that several terms and concept are applied when addressing the issue of a recommender, like item, recommendation, user's interest, prediction, rating, predicted rating, actual rating, prediction accuracy and prediction technique (Setten, 2005).

Literature Review

E-tourism

The Internet is by far introduced as a rapidly evolving medium, particularly for travel and tourism purposes (Schonland and Williams, 1996). Successful introduction to e-tourism is fully supported by various search engines, websites, blogs, on-line social networks, forums and other digital media which gain in importance particularly to consumers. In this respect, the information technology and the Web note profound impacts every-day functioning of the companies, as well as consumers' attitudes towards various aspects. Hence, they became dominant sources in consumers' use to access certain products. Due to its significance, this issue raised an interest within academia and practitioners. Generally, they argue regarding the understanding how search engines work and how travelers use the Internet and booking systems as tools in e-tourism (Morrison et al., 2001; Singh and Kasavana, 2005; Connolly and Lee, 2006; Pan et al., 2007; Buhalis and Law, 2008; Pan et al., 2011; Xiang and Pan, 2010). Moreover, the success of search engine marketing requires a good understanding of consumer behavior in order to provide the information desired by different consumers. Furthermore, the necessity of developing digital technology that will support the personalized services to address individual needs is fully justified. Tourism actors should collect customer information before,

during and after a visit in order to better understand consumer behavior choices and determinants (Buhalis and O'Connor, 2005). Additional insights regarding the progress of information technology in tourism domain is noted in many research findings (Kluge, 1996; Kirk and Pine, 1998; Frew, 2000; O'Connor and Murphy, 2004; Leung and Law, 2005; Law et al., 2009).

Furthermore, some researches addressed different approaches dealing with variety of relationships that appeared in e-tourism. So, Weber and Roehl (1999) explored demographics between Internet users and tourists at the same time. However, little research has been done on the travel-related behaviors of Internet travelers. In this respect, Morrison et al. (2001) found that some book travel on-line, while others go to travel agents or call the toll-free numbers of travel providers after getting travel information on-line. With regards to the behavioral dimensions, it may be utilized to segment travel markets as a powerful tool in managing e-tourism (Hennessey et al., 2008). Regardless of the approach, it must be underlined that tourism needed this kind of information some years ago, while today we face tourists with different travel patterns which cause different activity and are fully aware about their rights and obligations before, while and after the travelling.

Tourism Recommenders: Different Approaches

Due to rapid expansion of e-tourism, the tourism recommendation systems have attracted much interest in academia. Some of them in this respect elaborated the need for developing intelligent recommendation systems which can provide a list of items that fulfill as many requirements as possible (Mirzadeh et al., 2004; McSherry, 2005; Jannach, 2006). In the other side, others discussed a recommender system dealing with a case-based reasoning in order to help tourists in defining a travel plan (Ricci et al., 2002; Wallace et al., 2003). However, as the most promising recommendation systems in tourism domain are the knowledge-based and conversational approaches (Ricci and Werthner, 2002; Thompson et al., 2004). Yet, some other variants of the content-based filtering and collaborative filtering are engaged for recommendation, like knowledge-filtering, constraint-based and case-based approaches (Kazienko and Kolodziejski, 2006; Ricci and Del Missier, 2004; Zanker et al., 2008). In the same line, the recommendation systems based on a text mining techniques between a travel agent and a customer through a private Web chat may easily be applied (Loh et al., 2004).

Some recent academia work refers to more sophisticated outcomes than the forth mentioned. Namely, the introduction of a personalized tourist information provider as a combination of an event-based system and location-based service applied to mobile environment is suggested by Hinze et al. (2009). Additionally, Zhang et al. (2009) made an investigation on sources and formats of on-line travel reviews and recommendations as a third-party opinions in assisting travelers in their decision making during the trip planning. Noticeable are the findings regarding development of a web-site in order to enable Internet users to locate their own preferred travel destinations according to their landscape preferences (Goossen et al., 2009). Furthermore, the usage of the orienteering problem and its extensions to model the tourist trip planning problem is elaborated as efficient solution for number of practical planning problems (Vansteenwegen and Wouter, 2011). Also, many recommendation systems focus on selecting the destination from a few exceptions (Niaraki and Kim, 2009; Charou et al., 2010). It is evidently that this research area cannot be easily exhausted and results in improving dependability of recommendations by certain semantic representation of social attributes of destinations (Daramola et al., 2010)

Methodology

This section explains in more details the way how tourism recommendation systems actually work and the procedure how they produce recommendations to users. More precisely, it presents the recommendation process, the suggested algorithm as well as the proposed design and implementation.

Recommendation Process

In order to create recommendations valuable to tourists and travelers so they can create an ideal holiday or trip, the recommendation system must follow a specific process. Visually, this process is presented in Figure 1 and in Figure 2, but with certain differences. Namely, Figure 1 presents the recommendation process as a black box, whereas two sources of information needed as input, can be identified. The first source of information is the users' profiles, and the second is the information about the items or products. Ideally, the information stored in the profiles is related to user's preferences and should be given explicitly by the user itself. Yet, this information can also be extracted from other external sources, like websites. So, the information about the items can range from special metadata of the product, information extracted from the item, or the item itself

in case of electronic documents, thus producing databases of huge dimensions.

Furthermore, the final product of system may be a set of recommendations for the user. The final representation of these recommendations depends on the system itself but it may range from ordered lists of items, brief description of items, or the items represented on a map.

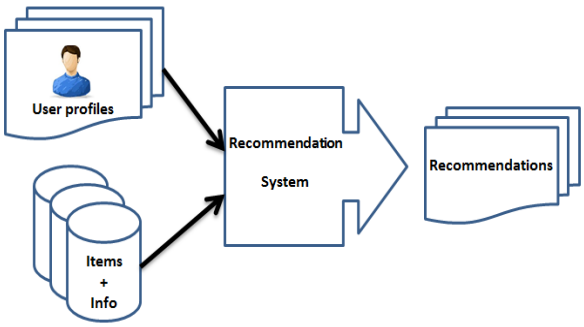

FIG. 1 RECOMMENDATION PROCESS AS A BLACK BOX

Figure 2 presents the recommendation process in a more detailed manner. Namely, the process includes the following steps: information recollection, selection, transformation, structuring and presentation, according to Setten (2005). It is noticeable that the information recollection step is the only one that is not done by the system itself.

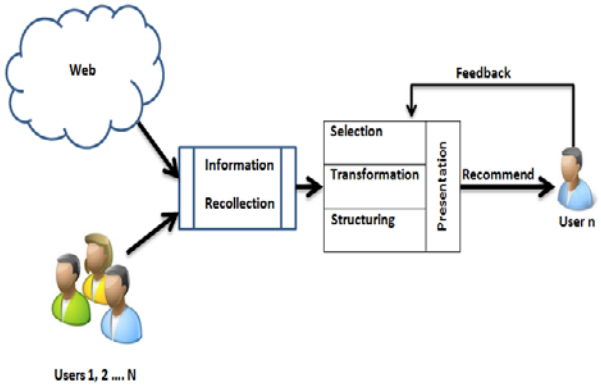

FIG. 2 RECOMMENDATION PROCESS

Recommendation Algorithm

In order to fulfill the main research objective, meaning to propose a methodology that will support tourists and travelers to identify relevant tourist objects that will match with their personal interests, a several step algorithm was developed.

The first step foresees tourist and tourist objects profiling. Tourist profiling is a two-step process which involves creating a profile and then reviewing the profile to make any necessary adjustments. For this purpose, the system uses and identifies a tourist type according to Gibson and Yiannakis (2002). Then, the system models the tourist personal profile using an N-dimensional vector, which is suitable for modeling. In this respect, each dimension corresponds to certain tourist type while the value indicates how much tourist identifies himself or herself with the corresponding type. Typically, individual tourist or traveler cannot be characterized by only one archetype but, has unique combination of these personalities, although varying degrees. Thus, tourist types model the tourists' generic interests in an abstract form.

Figure 3 presents the process of user profiling using vectors and depicts an exemplary tourist who likes to enact the role of an adventurer, followed by sport and cultural events, and rather dislikes sightseeing activities. By this, the chances for making "perfect" holiday or trip are much higher, thus resulting in positive experience.

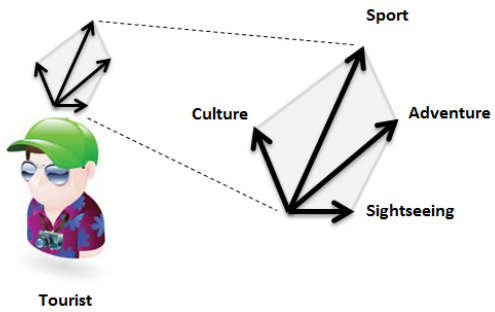

FIG. 3 MODELING TOURIST PROFILE BY VECTORS

As previously noted, the initial tourist profile for each system user is created by the user itself during the process of registration, by determining the degree of membership to each of tourist types. Considering the fact that consumer preferences change over time due to various factors, tourists might change their behavior too. To make the system capable to cope with these changes, there is a need for enabling tourist profile adjustment based on ratings that tourist gives to each tourist object after the journey (Eq. 1).

$$Uij_{t+1} = \frac{1}{2}(Uij_t + Rik_{t+1} * w * Okj) \quad (1)$$

Where: Ui denotes i-th user and Ui ∈ U

U denotes the set of users registered to system

Uijt denotes degree of membership in the moment t of i-th user to tourist type Tj and Tj ∈ T

T denotes the set of tourist types according to Gibson and Yiannakis (2002)

Ok ∈ O denotes k-th object in the set of all objects O

registered in system.

w denotes the weighting factor and Rik is the rating of k-th tourist object given by i-th user.

Similarly, the system may generate profiles for tourist attractions or events and every tourist object is modeled through a vector as well. Thereby, this vector describes in a quantitative way how much the object is related to the given types. For example, certain monastery or church may be highly relevant to a sightseeing tourist, but not one who is not keen on cultural heritage.

The next step is matchmaking algorithm which aims to match tourist profiles to set of tourist objects based on previously defined tourist types. The result is a ranked list of objects for each given tourist or traveler thus reducing the set of objects. If a tourist profile matches the characteristics of an object, this object will be recommended to the respective tourist, and so forth. Additionally, the algorithm has to examine whether they share similar structures. The more similarities they have in common, the more contributions the tourist object makes to tourist's satisfaction, thus being ranked higher.

Due to the fact that tourists' and travelers' behavior changes in the process of planning a vacation or trip, the recommended algorithm envisaged while planning the holiday, tourists like to be informed from other sources. More precisely, they rely on recommendations from reference letters, news reports, general surveys, travel guides, and so forth. So, they seek for comments and experiences from other tourists with similar preferences or people they trust. In fact, over 80% of travelers participating in a TripAdvisor.com survey agree that "reading other travelers' online reviews increases confidence in decisions, makes it easier to imagine what a place would be like, helps reduce risk/uncertainty, makes it easier to reach decisions, and helps with planning pleasure trips more efficiently" (Gretzel, 2007).

So, the issue of trust arises as significant variable in the algorithm. Experimental findings show existence of correlation between the trust expressed by users and their similarity based on the recommendations they made in the system. In this line, the more similar the two tourists are, the greater the trust between them is(Ziegler and Golbeck, 2006).

This recommended algorithm encompasses the collaborative filtering (CF) in order to calculate similarity between tourists who use the system. It is one of the most prevailing and efficient techniques that implements the idea for automating the process of "word-of-mouth" by which tourists recommend items to one another. Furthermore, it uses the known preferences of a group of users who have shown similar behavior in the past to make recommendations of the unknown preferences for other users. However, the CF faces many challenges, among which the ability to deal with highly sparse data and to scale with the increasing numbers of users and items, are the most important.

Design and Implementation

Figure 4 illustrates the proposed system architecture which actually presents a web-based portal built on a social network framework. It is noticeable that this module is significantly improved compared to certain active websites. Namely, this kind of portal provides tourists and travelers with customized, unique and enriched travel experience. Therfore, the consumer may be completely assured that the chosen itinerary justifies the expectations. The chosen item, in terms of holiday place, accommodation, event or whatever tourist objects, will fully match tourist's anticipations.

This architecture incorporates some standard plugins typical for social networks, like: Facebook, Twitter, LinkedIn, MySpace etc. However, it advances the concept including custom plugins, like the recommended objects plugin which is the core of the portal. It uses the Google Map for particular country territory in order to visualize both: static tourist objects (objects that are not temporary, like churches, museums, archeology localities, etc.) and dynamic objects (objects that have limited time duration, like events, expositions, etc.).

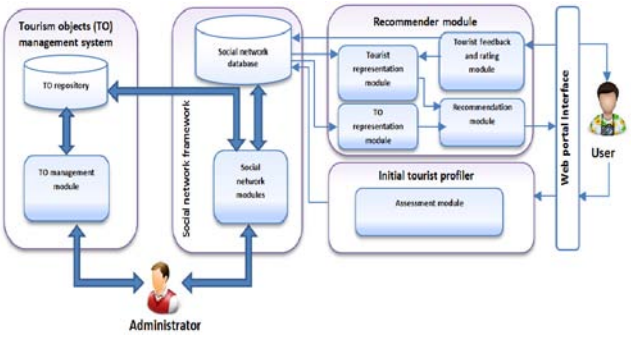

FIG. 4 SYSTEM ARCHITECTURE

Data Analysis, Findings and Discussion

The dataset used in this research contains 16320 ratings from 143 users for 318 tourist objects. Each user has rated at least 20 objects, and each object has been rated at least once.

The research was fully applicable to the case of Macedonia, thus using the Google Map of Macedonia to visualize particular tourist objects. For the purpose of testing the proposed recommender, offline experiments were undertaken. They are typically the easiest to conduct, as they require no interaction with real users and allow comparing a wide range of candidate algorithms at a low cost.

So, by using the sample dataset, we simulated the behavior of users that interact with a recommendation system. In doing so, it was assumed that the user behavior, when the data was collected, will be similar enough to it when the recommender system is deployed. This enables making reliable decisions based on simulation. Consequently, the final tailor-made product is a web-based portal at national level which can be modified to any particular tourist destination. Although being tested on relatively small sample size (territory of Macedonia), the applied methodology can be easily replicated and adjusted to any tourism-oriented country.

The module is user-friendly since it incorporates the basic social network plugins and applications. Besides them, the system implements the recommendation features through two main applications: trip planning and recommendation of tourist objects. Both of them use Google maps and display the tourist objects on the map according to their geographical location. Furthermore, the objects are grouped into contextual layers (cultural, sport, etc.) thus augmenting the Google map layers.

FIG. 5 PLANNING A TRIP

So, if a tourist is planning a trip, firstly he/she enters the preferred period of stay and the starting point of that trip. Then, the system suggests the optimal route to visit as much as possible objects of interest with the limited time period. Simultaneously, the system takes in consideration the weather conditions, average time necessary to be spend at each object, availability of transportation means and dynamic objects. The route is visually marked on the map (Figure 5). If the tourist uses the application from a smart phone, according to his current position, the system visualizes coordinates of the closest objects of interest.

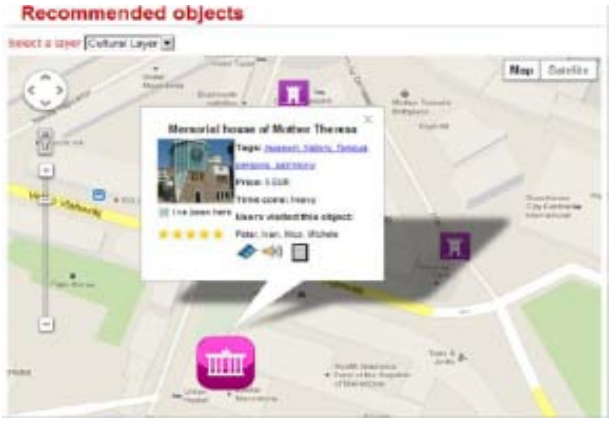

FIG. 6 RECOMMENDED TOURIST OBJECT

Furthermore, the system is capable of recommending tourist objects which are identified of interest to the tourist. They are displayed as icons whereas the image of the icon indicates the type of tourist objects such as a museum, church or restaurant. On the other hand, the size indicates how closely the object meets the tourist's interests. Each attraction also has an information window which includes name and picture of the attraction (Figure 6). If the icon has the shape of an umbrella, it is indicated that the attraction is accessible in the rain. The information window also displays general idea of opening hours of the attraction, friends who have visited the attraction, and an option to view narratives in either video, audio or text format. Through this window, the tourist may rate the visited object according to personal experience and satisfaction.

The final step is the process of evaluation i.e. to find out how to close the data used for offline evaluation match to the data the designer expects the recommender system to face when deployed online. So, prediction accuracy is one of the most exploited properties of recommendation systems and generally based on the quality of their prediction engine. In this line, this engine may predict user opinions over items (e.g. ratings of tourist object) or the probability of usage (e.g. visits). Since prediction accuracy is typically independent of the user interface, it is measured in an offline experiment by computing the Mean Absolute Error (MAE) as one of the most popular metrics (Eq. 2).

$$MAE = \sqrt{\frac{1}{|T|}\sum_{(u,i)\in T}\left|\hat{r}_{ui} - r_{ui}\right|} \quad (2)$$

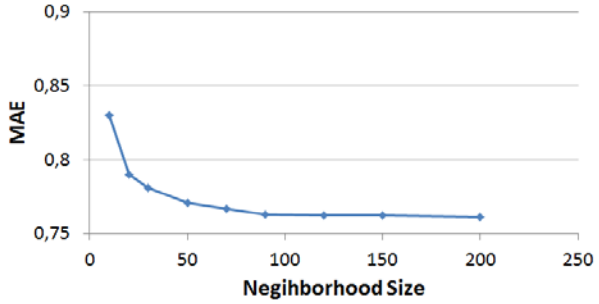

FIG. 7 MAE EXPRESSED WITH RESPECT TO THE NEIGHBORHOOD SIZE

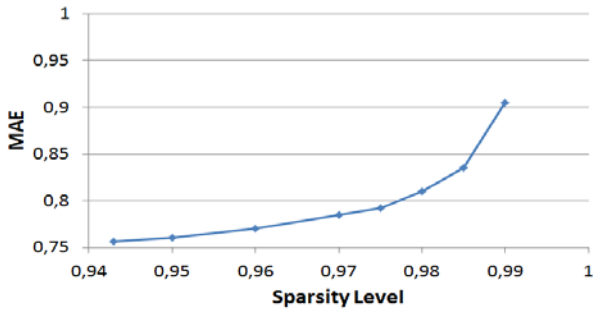

FIG. 8 MAE IN FUNCTION OF VARYING SPARSITY LEVELS

To evaluate the effectiveness of proposed methodology in alleviating the data sparsity problem, we have checked its performance in terms of coverage with the increase in sparsity level.

In this respect, Figure 7 shows the predictive accuracy of the algorithm i.e. the MAE expressed with respect to the neighborhood size. It is noticeable that the MAE improves as the neighborhood size increases but, it reaches a stable performance around 90 neighbors and any further increment makes no better or even worse results. Therefore, we have fixed the neighborhood size to 90 and performed the experiments with different sparsity levels. Figure 8 shows that the MAE changes with respect to varying sparsity levels i.e. It can be seen the impact of sparse datasets on the predictive accuracy. Furthermore, one may conclude that it performs as expected i.e. the predictive accuracy decreases as the sparsity level increases.

Hence, the evaluation results referring to the suggested web-based portal note satisfactory figures for accurate recommendations and guidelines.

Conclusions

The research supports the thesis that tourists can get maximum from a holiday or trip only if they use specificaly developed tourism recommender. They have a right to a tailor-made itinerary that will perfectly mach their preferences thus justifying the invested time and money. So, this empirical investigation strongly argues the necessity of creating such a software module that assists tourists and travelers to plan their ideal holiday in more intelligent manner. The outcome is a web-based portal which is very user-friendly since it incorporates the basic social network plugins and applications. The proposed model addresses the case of Macedonia, but it can be modified and easily adjusted to any tourist destination. The initial findings of the evaluation process lead to encouraging results for producing accurate recommendations and guidelines; implying that tourists will be offered a holiday fully responsive to their queries, resulting in satisfied consumer who got top quality service in accordance to preferences.

Furthermore, the research was limited by several factors that may be addressed in some future research, such as: sample size, the fragile tourism nature, limited secondary data etc. Yet, the discussed results and findings should be interpreted as selected samples to underline the usefulness of the proposed approach in contribution to tourism development and setting comprehensive tourism policy. So future work may include additional insights on improvement of presented web-based platform. Despite the forth mentioned limitations, the study is rich on useful findings and poses some valuable directions for further research.

Generally, the contribution of this paper lies in the fact that it proposes methodology for developing a module which relies on efficient and accurate personalized recommendation algorithm that supports tourist consumers to identify relevant tourist objects matching to their personal interests and to plan more efficiently their trips. Additionally, the empirical investigation may alarm the relevant tourism-actors that the time has changed and that the on-line experience has shifted from searching and consuming to creating, connecting and exchanging. Previously passive consumers and web surfers are now generating content, collaborating and commentating thus achieving their rights to enjoy the electronic communication as a fragment of the general economic interest services.

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