TO.DE.RE.S.: A WEB BASED PROTOTYPE SYSTEM FOR PERSONALIZED TOURISM DESTINATION DISCOVERY AND MANAGEMENT

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ABSTRACT

In the era of the Web, the problem of information overload is continuously expanding. A common scenario is when people get too much irrelevant information alongside relevant ones as a response to queries posed on the Internet. This paper introduces "TODERES" which is a web based prototype recommendation system that allows tourists to discover interesting Greek travel destinations that fit with their preferences combining information such as personal interests, accommodation and travel mode. The proposed system is created by employing various tourism-related photographs of places and activities taking place at Greece and by using Case-based Reasoning algorithm.

Key Words: recommendation systems, e-Tourism, personalization, user modelling, case based reasoning.

INTRODUCTION

Over the last decades, tourism is constantly developing in such a way that is considered to be one of the most important sectors globally, including Greece which maintains a very good rank in worldwide tourism. Tourism incorporates many of the features of the information society. Any person, regardless of its nation, its profession, its social rank or its education can become a potential tourist. The rates of growth that tourism sector possesses are higher than those of the total world economy. This growth can be influenced by several factors such as the growing social prosperity, the increase of leisure time, the new ways of communication and the population growth. Moreover, globalization and the emergence of new tourist destinations have created a competitive climate.

Information is very crucial in tourism sector so it has been among the first to exploit new technologies and innovations. Tourists need information before going on a trip to help them plan and choose between alternative tourist destinations. Technology has become an almost universal feature of the tourism industry. Information and Communication Technologies (ICTs) in general and Internet in particular, provide plenty of tools that enable the evolution of tourism demand and supply. Nowadays, tourism sector is supported by the development and the establishment of new technologies such as travel communities, blogs, travel review websites, photo galleries, visitor books, GIS applications, interactive maps and so on.

Buhalis (2003) presents several examples of the development of the tourist economy in connection with the international ICT areas of tourism industries focusing on airlines and travel, hospitality, tour operators, travel agencies, computer reservation and management systems. Internet for travel planning is used widely by the majority of tourists in order to obtain information on company sites, destination sites and on-line travel agency sites. Potential tourists are searching information on destinations and prices, places to stay, activities to do, airline fares and schedules, entertainment opportunities, local event calendars and similar tourist information. Major eTravel agencies such as Expedia, Travelocity, Lastminute, Orbitz and Opodo provide integrated travel solutions and a whole range of value added services, such as destinations guides, weather reports and insurance. Moreover, hotels use ICTs in order to improve their operations, manage their inventory and maximize their profitability. They also, use Internet for their distribution and marketing functions.

Intermediaries involved online travel agencies, as well as search engines, which are able to distribute static and dynamic information, like availability and prices. Nowadays, most hotels use booking opportunities through their own website, saving money on agency commissions. In addition, Web 2.0 as TripAdvisor.com, allows users to interact and travelers rely mostly on other traveler's reviews to plan their trips.

RECOMMENDATION SYSTEMS FOR DESTINATION DISCOVERY

With the explosive growth of Internet and the easy availability of information on the Web, we have entered a new information age. In the era of the Web, the problem of information overload is continuously expanding. A common scenario is when people get too much irrelevant information alongside relevant ones as a response to queries posed on the Internet. Recent advances in intelligent search suggest that these limitations can be partially overcome by providing search engines with more intelligence and with the user's underlying knowledge. Notable search agents on the Web include Google (www.google.com), altavista (www.altavista.com) and so on. However, in recent times another class of intelligent software applications that has gained relevance in addressing the problem of information overload when searching for relevant information on the Internet is recommender systems (Konstan, 2004).

Recommender Systems (RS) are a class of intelligent software applications that offer suggestions to information-seeking users as a response to user queries or knowledge gained during interaction with the user. They mostly leverage in-built logical reasoning capability or algorithmic computational schemes to deliver their recommendation functionality. Over the years, RS have enjoyed great application in the e-commerce domain because of their ability to provide assistance to information-seeking users. The main characteristic of the recommender systems is that they can personalize their interaction to each individual user. Personalization involves the design of enabling systems to capture or infer the needs of each person and then to satisfy those needs in a known context (Riecken, 2000). Personalized recommendations on commercial applications have been applied on Amazon (www.amazon.com), Ebay (www.ebay.com) and many other web sites. Lately, personalized recommendation systems have been gaining interest in tourism to assist users with their travel plans (Ricci, 2002). Triporati (www.triporati.com) is a web-based application in which users can discover their dream destination by selecting interests such as museums, tennis, class, architecture and so on. A personalization system is based on three main functionalities: content selection (selection of destination, tourist attractions, and accommodations and so on for planning a whole trip), user model adaptation (techniques used for maintaining updated user models) and presentations of results (technologies used for improving the interactivity of the systems and human-computer interaction such as GIS, multimedia, etc. (Kabassi, 2010).

The goal of this paper is to introduce "TODERES" which is a web based prototype recommendation system that allows tourists to discover interesting Greek travel destinations. It provides the users with services that he/she can choose his/her own destination that fits with his/her preferences combining information such as personal interests, accommodation and travel mode. The proposed prototype system is created, firstly, by employing various tourism-related photographs that show interesting scenes of different places and activities taking place at Greece. Users can choose the photographs that best characterize and describe their place of interest or activities they prefer and fit their likings. User's tourist profile can be generated according to his/her preferences. Taking into consideration this profile, the prototype system recommends users, the most available destinations alternatives by using the case-based reasoning (CBR) algorithm, that is, by comparing the older cases with the new user. This CBR technique is employed to support information search and choice processes that help users to discover ideal tourist destinations according to their preferences.

CASE-BASED REASONING (CBR) APPROACH

This system has been implemented using case-based reasoning algorithms and methods. This prototype system acts according to customer behaviors, takes into consideration potential tourists' preferences and reacts quickly to their choices by predicting their ideal Greek destinations. The method of CBR is an algorithm in which the learning process continues the whole time.

Case-based Reasoning (CBR) is a well established research field in Artificial Intelligence that involves the investigation of theoretical foundations (Hüllermeyer, 2007), system development and practical application building (Bergmann et al., 2003) of experience-based problem solving. The core of every case-based problem solver is the case-base, which is a collection of previously made and stored experience items, called cases. A case-based problem solver solves new problems primarily by reuse of solutions from the cases in the case base. For this purpose, one or several relevant cases are selected. This selection process is guided by one of the core assumptions behind CBR, namely that similar problems have similar solutions. Once similar cases are selected,

the solution(s) from the case(s) are adapted to become a solution of the current problem. Finally, when a new (successful) solution to the new problem is found, a new experience is made, which can be stored in the case-base to increase its competence, thus implementing a learning behavior.

The essentials of CBR are captured in a surprisingly simple and uniform process model proposed by Aamodt and Plaza (1994). The first step of CBR system is case representation. A case must contain the problem composition, its solution and its output. In this perspective, a CBR system can be defined by four iterative steps: (1) **retrieve** the most similar cases to new problem from case base, (2) **reuse** the solutions of these recovered cases. If necessary, adapt their solutions to resolve the new problem by creating a suitable solution to him, (3) **revise** the exactness and the usefulness of adapted solution in previous step and (4) **retain** the new solution in the case base in order to use in the future.

Figure 1
The CBR Framework (Aamodt & Plaza, 1994)
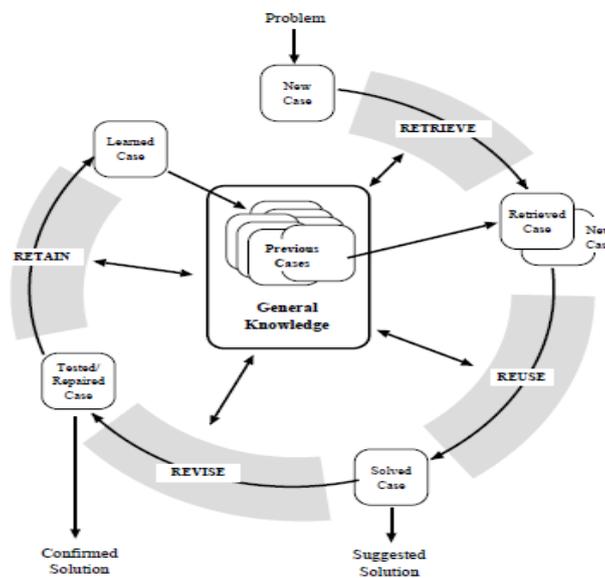
It is necessary to decide which attributes should compose a case and what representation language is better suited to represent the knowledge involved in the problem solving process because it creates data structure that can be held in the memory to speed up the search process focusing on the most relevant dimensions (Lorenzi and Ricci, 2005).

### SYSTEM DESIGN AND DEVELOPMENT OF "TODERES"

The following section describes a system that allows tourists to discover interesting travel destinations. In the past, people obtained suggestions for their personal tourism from their friends or travel agencies (Cao et al. 2010:2274). Such traditional sources are user-friendly; however, they have serious limitations. First, the suggestions from friends are limited to those places they have visited before. It is difficult for the user to gain information from less-traveled members of the community. Second, the information from travel agencies is sometimes biased since agents tend to recommend businesses they are associated with. Even worse, when users plan their travel by themselves, they often find their knowledge is too limited to produce a satisfying travel experience. Thus, the implementation of a user-friendly and effective system for the task of tourism recommendation was the primary goal.

Design Decision

An overview of the system is illustrated in Figure 2. Users communicate with a web server over the Internet. The web server provides a tourist destination recommendation service. After receiving preferences from the users, the server will produce and suggest the users with at least up to six ideal Greek tourist destinations recommendation based on personal profiles and user preferences. Personalized profiling and destination recommendations are the two main key elements that the proposed model is focused.

The user's (potential tourist) first experience using "TODERES" begins with the creation of a personal tourist profile. The tourist's profile becomes the foundation for generating the desired travel experience for the user. This profile is used to recommend Greek tourist destinations to the user. Brief information about each destination is provided, such as hotels, restaurants, events and attractions.

Figure 2
"TODERES" System Overview
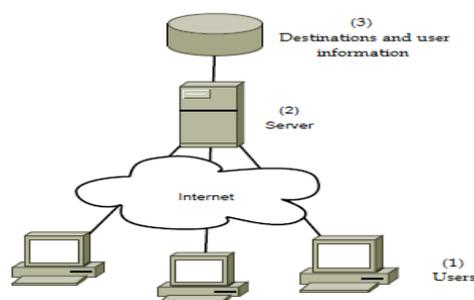
Profiling

Tourism recommender systems supporting users in their decision making process by suggesting suitable holiday destinations based on user profiles are an area of vivid research. An efficient and accurate travel recommender system needs to understand the experiences that individual travelers may desire and prefer. By generating a profile of the traveler's personal interests, the system is able to recommend destinations that the user will enjoy. Taking into account the previous and the paper of Berger et al. (2007) who implemented a Web-based tourist profiling tool based on photograph selection, we believe that the most intuitive way to describe a place is to show the user images so that they know whether or not they would like such a place as well as a profile of the user's likings can be generated by using particular tourism-related photographs.

Therefore, the user profiling of the "TODERES" prototype system is accomplished not by requesting the user to answer a predefined set of questions or filling out a tedious survey as currently are proposed by the most tourism recommender systems. Instead, the system employs tourism-related images that illustrate various interesting scenes of different activities and places in order to help users describe their interests best.

Methodology of the proposed system

Case-based reasoning (CBR) methods and algorithms are used that replies automatically to the users, by analyzing customer behaviors and preferences. The principal characteristic of this method is that allows the specific knowledge usage by remembering a similar proceeding position and reusing the knowledge of this position. It is differed from other Artificial Intelligence techniques, because they depend on the general knowledge of a problem domain.

The reason of the choice of this technique is that tourism concept depends on experiences. So, implementing a system which uses old cases that contain travel preferences will obtain more convenient solutions. It is desired to create a recommendation unit suitable to tourism concept. Therefore, this method seemed the closest solution to this wish. In addition, there are several studies and applications realized for tourism sector which are using the method of case-based reasoning and confirms the appropriateness of its use in this system (Cavada et al., 2003; Venturini & Ricci, 2006).

Furthermore, because system's user profiling technique is based on images, technique of tagging is exploited. Tags are informal annotations attached on the web resources to describe characteristics. Tagging is a method of extracting the contents of photos and finding what the user might be more interested in. Nowadays, social tagging allows users to attach descriptive keywords to places; therefore tags are useful in helping provide rich information about a place or an activity. In "TODERES" system, tags are used in order to detach the descriptive characteristics of images that are selected by the user. Then, tags are processed in such a way so that the most accurate recommendation of destination is generated.

The system compares the similarity of cases with the new case to find the best solution for the user. For that reason, a method to calculate similarity coefficients which is going to determine the alternatives which will

be proposed to the user is necessary to be developed. In this respect, inspired by Jaccard model, the calculation formula of similarity that applied is the following:

$$C_i = \frac{\sum_{i=1}^{n} W_i\, a_i}{\sum_{i=1}^{n}(W_i\, a_i + W_i\, b_i + W_i\, c_i)}, \quad \text{where } a_i = \begin{cases} 1, & \text{if the parties are matched,} \\ 0, & \text{otherwise} \end{cases}$$

In the above formula, "α" represent the properties found in both of the cases, the new case and every registered case in the case base; "b" the properties found only in the new case; "c" the properties found only in the registered case.

The use case illustrated in Figure 3 describes the situation when a user requests recommendations for tourist destinations. The process is the following:

1. End user request recommendation.
2. End user selects images that represent his preferences on travel interests, accommodation and travel mode.
3. End user can either save his profile or request recommendation results.
4. "TODERES" prototype system retrieves old similar cases from the table that previous cases are kept and compares the new case with the registered one. The algorithm performs similarity matching and when procedure ends the results are ordered from the biggest to the smallest.
5. "TODERES" prototype system retrieves the destinations that best match to the preferences of the user from the destinations table. If destinations retrieved are already selected from the previous step then destinations are ignored. Otherwise they are presented to user in order to obtain users behavior.
6. "TODERES" prototype system completes the process by presenting the results to end user.

Figure 3
"TODERES" System Overview
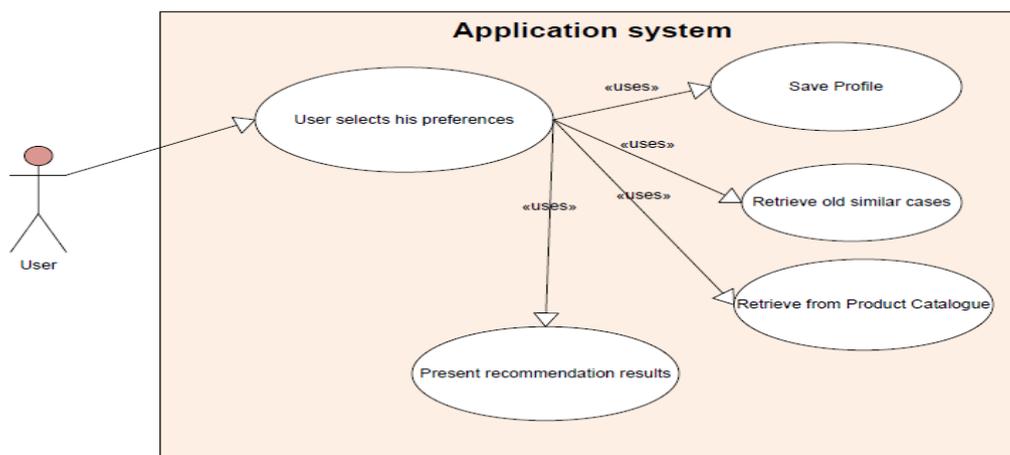
Development environment

Although both JSP and recently PHP take advantage of Object Oriented Programming which would fulfill the minimum requirements of programming the development, the amount of available Java libraries and the scalability that JSP brings the medium size web applications gave weight to developing the system using JSP with struts framework. Struts is a framework that structures all the components of a Java-based Web application into a unified whole. There are many different Java development environments available, the most being Eclipse and NetBeans. Whilst Eclipse provides strong support for developing a Java application, the "TODERES" system was implemented in Netbeans IDE 7.0.1 platform due to the needs of a Web server for testing the environment. Netbeans IDE 7.0.1 has already integrated the GlassFish Server 3.1.

The database was constructed on MySQL platform to facilitate the integration of the interface and the software with databases. MySQL is a Relational Database Management System (RDBMS) that runs as a server providing multi-user access to a number of databases. The MySQL development project has made its source code available under the terms of GNU General Public License. Free-software-open source projects that require a full-featured database management system often use MySQL. Many programming languages, including Java

use a Java connector for accessing MySQL databases. In this project MySQL Connector for Java version 5.1.17 is used.

Database Structure

The database is a key aspect of the project as it is used to store the entire data. "TODERES" prototype system consists of the following tables:

- **Destination:** this table lists Greek tourist destinations.
- **Profiles:** this table keeps the users' preferences as the user has selected from the application. That is, preferences refers to interests/activities, accommodation and travel mode.
- **Photos:** this table stores travel-related images.
- **Case_base:** in this table information and preferences of every registered user are kept as a case.

Determination of criteria preferences interests

"Interests" plus "Accommodation preference" plus "Travel Mode" plus "Age" are the similarity determinants chosen in order to retrieve potential tourists' preferences. All these facts compose decision-making process for the tourists. The next stage was to determine the weights of every criterion rather found in the case base. "Interests" has weight 0.5, "Accommodation" has weight 0.3, "Travel Mode" has weight 0.15 and finally "Age" has weight 0.05. The system is implemented in a way that whatever the weights are, the code would work correctly because the weights in the system are variables of the proposed model.

Composition of the interface

An interface is used for connecting the user and the infrastructure of the prototype system. Users declare their interests by selecting images that best match their desires. Potential tourists have the possibility of saving the selected travel preferences in order to accomplish an interactive approach with the application; that is, user can add their comments or rate suggested destinations in order to evaluate his preferences and behaviors. For instance, during the first interaction (Figure 4), the user selects the images illustrating "Holy" and "Festivals" as his personal interests. During the second interaction, the user selects the images illustrating his/her preferences in accommodation. During the third interaction, the user selects the image illustrating the travel mode he/she prefers. Once the profile declaration is finished, the system implements CBR methods and algorithm and calculates the similarities between the cases, in order to propose a personalized list of destinations that the user can select, as illustrated in Figure 5.

Figure 4
"TODERES" System - Images selected that declare the interest of tourist
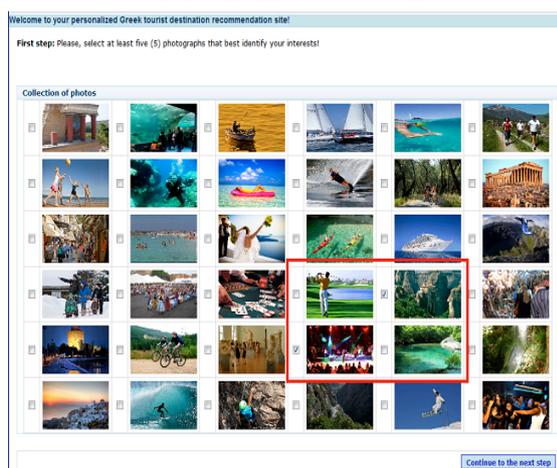
Figure 5
"TODERES" System – Personalized list of ideal Greek Destinations
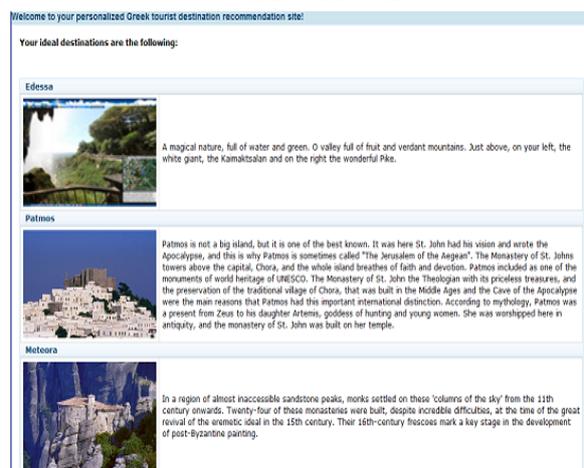
CONCLUSIONS

The future of e-Tourism will be focused on consumer-centric technologies that will support organizations to interact with their customers dynamically. Consumers are increasingly able to determine elements of their tourist products. Innovative tourism enterprises will have the ability to divert resources and

expertise to servicing consumers and provide a higher value added transactions. The development of new and more powerful ICT applications empowers both suppliers and destinations to enhance their efficiency and re-engineer their communication strategies. Innovative technologies will support interoperability, personalization, and constant networking (Buhalis and Law, 2008).

The goal of this paper was to propose a prototype system that contributes in discovering ideal Greek destinations according to personal preferences and desires of potential tourists. In addition, this system can enhance users' preferences in decision-making process and via this procedure eventually to retrieve realistic internal wishes and desires. CBR algorithm, which is the resolution process of new problems based on similar old problems, was a better choice for the composed system.

For the application party, it was necessary to realize many steps in order to compose a recommendation system. First of all, it was necessary to define the detailed structure of the proposed prototype. Next, database was constructed in MySQL platform and tables were filled with data. Then, the interface was developed using Java technology with struts framework. The next step lay in preference definitions and their weight depending on their importance degrees, for a future comparison by algorithm. The last step was the writing of the algorithm that implements CBR methods and algorithm and calculates the similarities between the cases, in order to propose tourists alternative which are the most similar ones already preferred by previous cases.

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