INTOUSYS:
a prototype of personalized tourism system

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Abstract. By “personalized tourism” is intended a way to offer a tourist services adequate to his culture, interests, experience, time and money to spend, and any other aspect related to his personal way of life. Informatics and artificial intelligence can respectively give a great contribute to the development of systems able to support in such a way a person, the former by technologies for developing suitable system and network architectures and data transfer protocols, the latter by user modeling techniques. In this paper we first illustrate the main features that a personalized tourism must offer to a user, then we present in some detail technologies and protocols of a client-server system architecture, where clients are implemented on mobile devices. In particular we illustrate features, available on mobile devices, for planning a personal itinerary, recognizing the art works by geographical localization, recording the places visited and the degree of the user satisfaction.

Keywords: personalized tourism, cultural tourism, mobile devices, user modeling, GPS technology.

1 Introduction

Cultural tourism has without a doubt become a mass phenomenon with an extremely important growth trend. This makes it attractive to design and develop support and assistance systems capable of introducing personalization elements to satisfy even the most demanding tourist.

As tourism, cultural tourism is a mass phenomenon when considered in relation to the number of persons who engage in it.

But actually, its true nature lies not so much in “tourism” as in “cultural” – the word that better identifies and characterizes it. Cultural tourism is any human activity that leads people to visit artistic and cultural assets, generally available in museums, palaces, monuments, and archaeological sites. There are a great many ways – almost all distinct from one another – for an individual to take part in these activities. One may easily see that this consideration does not hold true for other recreational or entertainment-related activities – just consider, for example, a person’s attendance at a sporting event. Indeed, in this case, the degrees of freedom granted to the individual are extremely reduced, as the date, the time, and players are all set and unchangeable. While individuals retain the possibility of choosing their seats, they have no influence
at all on the outcome of the game, which remains independent of their will and desires.

But in cultural tourism, individuals, while still part of the “mass,” enjoy many degrees of freedom: no longer bound by dates and schedules, they can choose their itineraries, make longer or shorter visits or ignore a work altogether, use written notes and commentaries, audiovisuals, and even specialized guides that speak their language, return whenever they want, and so on.

Cultural tourism thus means “personalized” tourism. In fact, clearly, given the numbers of tourists, we are highly unlikely to identify subjects marked by the same behaviors and the same expectations. The level of culture and curiosity – and the availability of such resources as time and money – have a decisive influence on the modes of personalized enjoyment of the artistic/cultural asset. There is no cultural tourism other than personalized cultural tourism.

How can technology foster the personalization of cultural tourism? It does so essentially by permitting the delivery of three fundamental services.

The first service, here called “information service”, consists of allowing easy, efficient access to the largest possible quantity of information. Today, this is ensured by excellent assemblages of technologies: the Internet (network architecture and TCP/IP protocols), the World Wide Web (http protocol), and lastly, the enormous output and availability of databases and data warehouses (SQL and XML). This basic service is not yet aimed at full-fledged personalization, since the faceless mass of tourists can use the service without any kind of distinction.

The second service, here called “personalization service”, consists of the possibility to appropriately filter the available information to the advantage of each individual. For example, a tourist who is an expert in Roman history and visiting the Palatine Hill might be offered an itinerary emphasizing discoveries more recently brought to light (for instance, the remains of the Pomerian wall on the northwest side) or in particular detail (such as the locations where the Lupercalia were held), while for a tourist with only elementary knowledge of Roman history, the classical tour of the Temple of Jupiter Stator and the like may be recommended. And that’s not all. A good personalization service would not merely recommend itineraries suited for the culture and level of interest of each individual. It would also memorize the sites already visited, making reference to them as the tour continues, and on subsequent visits to the same places. For example, a tourist visiting Pompeii who has already been to the Palatine may be offered additional, more detailed information on Roman patrician dwellings and the construction techniques of the Baths. This information screening service is key to the definition and personalized presentation of tour itineraries, and is thus the very nucleus of personalized cultural tourism. The technologies for developing this service have yet to achieve sufficient levels of consolidation to be adopted in official or de facto standards. The technology of reference, known as “user modeling,” is a branch of artificial intelligence; although still the subject of study and trialling, it has defined architectures and components sufficient for developing user models suitable for personalizing information in support of cultural tourism.

The third service, here called “localization service”, is simply that of position finding. This consists of making tourists’ geographical positions available at all times, in order to locate and guide them as they travel. With this service, each individual may, whenever he or she desires, request information on the works located in the geo-
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This service proves particularly useful for visits to archaeological sites, where the identification of archaeological elements is not always clear – just think of the remains of walls and building foundations. But although apparently simple, it presents some considerable difficulties in its development. Its technologies are based essentially on the Global Position System (GPS) which provides the geographic location. All you need is a small, handy GPS device to obtain – in open locations such as archaeological sites – your geographical coordinates at any time. Difficulties arise when we wish to use this information (the geographical coordinates supplied by the GPS) in a client/server system on TCP/IP network architecture using the http protocol. The lack of standards on the one hand, and the necessary barriers protecting network information technology systems on the other, together produce problems for developing open systems to fully exploit this service.

Many experiences and projects have been recently focused on these kind of problems. Their approaches differ in sensible way. In [1] a system using PDA without localization and personalization is presented. In [2] and in [3] systems with localization services without user modeling are presented. The agent technology integrated with ubiquitous computing and localization are presented in [4] and in [5]. More advanced systems are described in [6], where a system including an affective guide with attitude that links its memories and tourist’s interest to the geographical position integrates PDA with GPS in a cognitive modeling environment is presented and in the LOVEUS project [7] that integrates mobile computing equipment with several localization technologies and with user profiles.

This work presents the fundamental lines of a system for personalized cultural tourism based on the delivery of the integration of the three services described above; it’s named INTOUSYS (Intelligent Tourism System). The system’s overall architecture will be presented, and its individual components, the functionalities it makes available, and the requirements and procedures for use will be described. Particular emphasis will be given to the development of the position-finding service through the presentation of a solution for communicating, via http protocol, the geographical coordinates acquired from the GPS device.

2 System Overview

The main requirements for the system are:

- it is a client-server system accessible on the world wide web;
- the server stores information about archeological sites in a data warehouse; a web-gis component is also provided;
- as a client, the user needs a portable equipment (computer or a PDA or a 3G mobile telephone) enabled to Internet connection; a GPS device must be also connected to the portable equipment (or integrated with);
- the user interact with the system only using a web browser;
- the geographic position (a couple of geographic coordinates detected by the GPS device) is transmitted from the portable equipment to the server via the http protocol, that is by using the browser; this is accomplished by a specific
module (for example an Active-X component for browser running under MS Windows operating systems), that is downloaded on the portable computer the first time the user access the system;
- for each user the system constructs a user model, which is stored on the server; a specific module manages the user models.

Fig. 1. System Intercommunication diagram

The system acts as an assistant for a tourist visiting a archeological site (where GPS service is active). The tourist must have a portable equipment (PDA or 3G mobile telephone) connected to Internet by GPRS/UMTS technology and a GPS device integrated or connected to the portable equipment (via Bluetooth technology, for example) as showed in Fig. 1. Further, the first time the tourist access the system via Internet using a web browser, he/she can download a module for enabling the communication of geographic data via http protocol. As a second step the user modeling component of the system perform a simple interview with the tourist, in order to capture his/her culture, interests and so on. These two preliminary operations (download of the module and user modeling interview) have to be performed only once and in any place served by Internet. At this point the system is always able to act as an assistant for the user. Every time the tourist connects his portable equipment to the system, he/she is recognized together with his/her geographical position. The tourist can interact with the system asking information about cultural site, cultural programs and events, shops, hotels, car rentals and so on. The system will answer taking into account the geographic position and the user model of the tourist. However, the typical operation that characterize the system is the following: when the tourist is close to an archeological site and asks for information about it, the system identifies the archeo-
logical site by means of the geographical coordinates and furnishes the user with the appropriate information.

3 Information service. The Data Warehouse design

Information supporting tourist’s visiting are stored in a data warehouse. Information concern archeological sites as well as commercial and travel information. Information is structured in two great categories: major sites and minor sites. Major sites are vast sites including several cultural elements (for example, the Palatine Hill is a major site). Minor sites are limited to one single structure with few cultural elements (for example, the Traiano’s Column).

The implementation of major and minor sites is defined by frame logic. Each cultural site is represented by an entity with a certain number of relevant objects. The entity and its objects are defined by classes that define a domain of attributes. The following is an example for the entity temple:

Entity temple [name => class definition;
   consisting of => class objects;
   located => class position;
   satisfaction => class interest;
   .........]

definition [name => string;
   period => string;
   year => number;
   description => string;]

In order to identify similar or correspondent objects, classes and attributes representing cultural sites are analyzed. This is implemented by a cultural correspondence table for Entities. For example, if the Entity A has as element a mosaic Rom1 and the Entity B has a similar mosaic Rom2, the following relation:

Entity: A => Object: mosaic Rom1
Entity: B => Object mosaic Rom2
[details about similarity]
[details about the correspondence]
[user profiles]
[details about other fonts]

will be added to the cultural correspondence table.

Cultural correspondence table is used to retrieve information about cultural objects and also for the personalization by means of the user modeling module. In fact, [user profiles] in the above example grouped the users interested to the relation. This information is used by the system component which manages the user model.
4 Personalization service. The user modeling component

The classical methodology based on initial interview for each tourist is here adopted. The basic model is then automatically adapted during the visiting by analysing the tourist’s behaviour, following the “set of objects visited with high interest” criterion, implemented by taking advantage of the geographical position of every object (archaeological finds in archeological sites). The client module performs a sampling of the tourist’s position at regular intervals of time (for example, every 10 sec). When the sampling points out the presence of a archaeological find in the tourist’s range, a timer starts and will stop when a successive sampling will detect the tourist’s living from that archaeological find, allowing to calculate the visiting time which will be used to adapt the tourist’s user model. Others technique are implemented to prevent from wrong evaluation of the tourist’s behaviour, such as chance encounters. The user model allows for the visiting programme generation. Every time the user model is adapted, also the visiting programme is updated.

The representation of the cultural profile consists of two parts: Header and Body.

<table>
<thead>
<tr>
<th><strong>Header</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure of the components: <code>&lt;attribute, value&gt;</code></td>
</tr>
<tr>
<td><strong>Broken down into the following sections</strong></td>
</tr>
<tr>
<td>• User information (registration data and access data).</td>
</tr>
<tr>
<td>• Path information (data on the visit path taken, times and procedures, and comments on satisfaction).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Body</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure of the components: <code>&lt;attribute, value, weight, class, Id, flag&gt;</code></td>
</tr>
<tr>
<td><strong>Role of the structure’s elements</strong></td>
</tr>
<tr>
<td>• <strong>Attribute</strong>: represents all the categories into which the information domain is subdivided.</td>
</tr>
<tr>
<td>• <strong>Value</strong>: represents the topic corresponding to an attribute.</td>
</tr>
<tr>
<td>• <strong>Weight</strong>: each component has its importance within the model; it may take on values between 0 and 255 as suitable for indicating (in increasing order) the component’s level of influence within the user profile.</td>
</tr>
<tr>
<td>• <strong>Class</strong>: the user profile may be broken down into a number of sub-profiles (classes).</td>
</tr>
<tr>
<td>• <strong>Id</strong>: univocal identification code of the attribute-value component within a specific class.</td>
</tr>
<tr>
<td>• <strong>Flag</strong>: the component is given this field for control activities as needed.</td>
</tr>
</tbody>
</table>
According to the analysis of the information domain, the cultural profile’s body is divided into nine classes: History, Art, Environment and Wine & Food, identifying the characteristics of the cultural preferences; Content, Feedback, and Movement, identifying the preferences for behaviour and interaction with the system; and Shopping and Restaurants, identifying the preferences regarding commercial services.

The generation of a visit path suitable for the tourist’s preferences corresponds to the selection, from time to time, of the best site to be visited in accordance with the user’s preferences present in his or her cultural profile. The system’s customization is represented through the interaction of four main modules:

- Profile MEST (cultural profile Extension Module)
- Path MEST (visit path Extension Module)
- Content MEST (content Extension Module)
- MAQ (Acquisition Module)

5 Localization service. The geographical communication module

Mobile devices are currently connected to Internet by GPRS/UMTS technology and in the future it is conceivable to expect a broadband connection like WiFi in order to give better performance in the exchange of information. Even if broadband connection were available for mobile devices over a vast portion of territory, it would still lack a standard protocol or interfaces to exchange GIS-oriented information between them and Data Centre installations. The purpose of this research is to produce an interface to exchange geographical information between different commercial Web-GIS product and mobile devices over TCP/IP connection using only standard protocols like the HTTP protocol.

A user equipped with a mobile device can produce mainly two kinds of data for our purposes: data associated with his geographic position (GPD Geographical Position Data) and data associated with objects (GID Geographical Information Data) that are the main concern of his cultural visiting. The former can be captured by a GPS integrated or connected to his mobile device and the latter is typically recorded on a file that can be retrieved, analysed and associated to the geographic position on a later step. Web forms are a useful tool to transfer information (in our system forms are used to perform the preliminary user modeling interview) in the correct format for a database to be stored; analogue tool should be available for communicating geographical information to a system. A common feature like the application server environment can be used to develop a module to transfer data. The application server in turn can understand HTTP protocol via a GPD and GID sharing services. A common interface should be able to communicate geographic and analytic data via HTTP protocol between client and server as a browser does with a Web Application.
6 Conclusions

A prototype of the system is currently being developed in order to make empirical 
evaluations of the implementation solutions adopted from the standpoint both of ar-
chitecture (adaptability to mobile devices, Client-Server communication, etc.) and of 
processing logic (technique for customizing content and predicting the user’s behaviour). The P-Culture working group has proposed developing an application of the 
system as part of the national competition “Giovani idee cambiano l’Italia” (“young 
ideas change Italy”). The project, entitled ADMIRE, is proposed as a customized tour 
guide (usable by Pocket PC with GPS position finder) for the city of Salerno.

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