Post-via: After Visit Tourist Services Enabled by Semantics

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Abstract. The Internet has disrupted traditional tourism services. Thus, knowing tourists' travel experience becomes a privileged tool to enable new business strategies based on the feedback provided by the tourists themselves. Post-Via captures and effectively manages tourists' feedback and, based on semantic technologies, integrates opinions and services to enhance tourists' loyalty. In a nutshell, Post-Via tries to unite on one platform the necessary components to perform traditional Customer Relationship Management functions and opinion mining techniques to provide services of direct marketing using web semantic components and recommender systems.

Keywords: Semantic Technologies, Tourism, After Visit Services, Ontology.

1 Introduction

Tourism encompasses all kind of heterogeneous activities related to tourists' needs satisfaction, and borrows from equally uneven multiple activities [1]. In this kaleidoscopic scenario digital networks are transforming tourism in depth, as long as the importance of the Internet for travel and tourism industry has dramatically increased over the past few years [2]. ICT praxis in tourism industry is heavily affecting how its products/services marketing is planned and managed and generating strong and permanent changes in its distribution systems [3]. This ICTs impact is becoming increasingly stronger and unanimously considered as an substantive breakthrough for this sector competitiveness[4].

The tourism sector is composed of heterogeneous agents whose boundaries between competition and cooperation have evolved (and blurred) with the use of the Internet, resulting in a massive re-organization of the markets and the industry as a

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whole[1]. One of the main actors in tourism business are tourism organizations. Focusing on those players, ICT contribution has also changed radically their efficiency and effectiveness, changing the way their businesses are conducted in the marketplace, as well as how they interact with consumers[5]. This timely ICT contribution can of course boost staff morale, managerial effectiveness, productivity and profitability for these players [6], but only if they are able to quickly respond to the changing demands of customers and suppliers, and to new opportunities and environmental needs [7].

This paper presents Post-Via, an ICT platform devoted to support after visit tourist services offered by local tourism organizations by delivering relevant after visit raw data and assorted analytic tools. The remainder of the paper is organized as follows: Section 2 surveys the relevant literature about semantic technologies and their use in tourism environments. Section 3 describes Post-Via project. Section 4 brings the main project conclusions and depicts future works.

2 Literature Review

Semantic technologies ever-increasing presence in the ICT domain has been driven by the works of Tim Berners-Lee [8]. Semantic technologies lay on a set of technologies among which the Ontology is the main one. Ontologies define common, shareable and reusable views of a domain, and they give meaning to information structures that are exchanged by information systems [9]. The use of semantic support in ICT-based solutions allows the introduction of "intelligence" in software based systems, making it possible to introduce computer based reasoning and so enabling process automatization [10] and the performance of sophisticated tasks [11]. Several authors have highlighted the importance of semantic technologies in organizations. Ding [12] stated that the semantic web is fast moving in a multidisciplinary way and Breslin et al. [13] confirmed that industry is adopting semantic technology applications. In sum, Semantic-based technologies have been steadily increasing their relevance in recent years in both the research and business worlds [14].

As a result of this, semantic technologies and tourism have work together in the past. For instance, [15] proposed a semantically enriched recommendation platform for tourists on route, later expanded to Destination Management Organizations [16]. [17] presented a semantic technology based platform to support cultural tourism. [18] used ontologies combined with Bayesian networks to provide recommendation in the context of the city of Tainan (Taiwan). Recommendation is the field of study chosen by [19] to design and present a tool based on semantics and fuzzy logic. And more recently, in [20], authors present a Web-based system that provides personalized recommendations of touristic activities properly classified and labeled according to a specific ontology, which guides the reasoning process. Finally, [21] provide personalized recommendations of cultural and leisure activities when the tourist has already arrived at the destination partially based on semantic technologies.

However, these works are not focused on dealing with tourists once the trip is over. It's the main aim of Post-Via.

3 Post-via: Architecture and Implementation

Post-Via 2.0 platform is based on the conviction that information and communications technologies (ICT) can be heavily applied to the tourist domain with the aim of significantly improving quality of those services offered by tourism providers to final users.

This section presents the semantic architecture proposed for Post-Via project. Firstly, the main architecture of the whole system is showed describing briefly the workflow and the use of the semantic infrastructure. And secondly, a detailed description of the semantic component is provided. Finally, an example of the use of the semantic model is presented showing a couple of examples of the SPARQL queries which will be launch against the model.

3.1 Main Architecture

The main architecture of the entire Post-Via platform is depicted in Figure 1. As can be seen Post-Via is made up of several components which are interconnected using the Model-View-Controller pattern design.

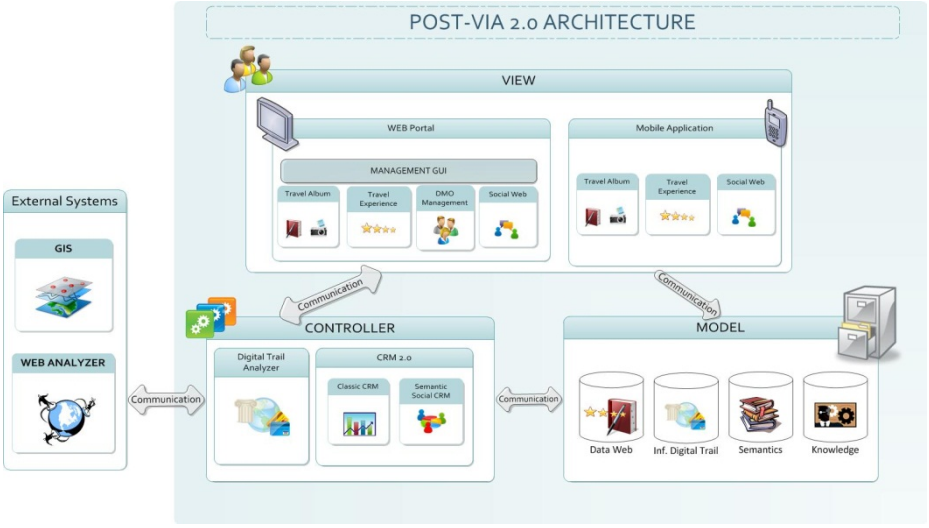

Fig. 1. Post-Via Architecture

In this paper, the semantic component is explained in detail, paying attention to the main entities which make up this component, and the relations among them. The behavior of the platform depends on user needs. However, most of the interactions of the platform will make use of the semantic model. This is because Post-Via has been designed as a semantic platform (a platform with an internal behavior based on semantic technologies). This means that most of the useful information of Post-Via, provided by the user is stored using the semantic model.

Each query or data entry in Post-Via makes use of the semantic platform and the relational database. When a user introduces data in the platform, this information is divided into several items depending on the entities which affect the data introduced. Once the information has been divided, an internal ID is assigned to each of the parts of the data. The main information is stored in the semantic model using this ID as part of the URI of the different instances which will be created (for example, a user with ID 45 will generate at URI like http://postviahost.com/postvia.owl#USER45). At the same time, this ID is stored in the instances with the "id" data property value. Also, in the relational database, the additional information about the data introduced is stored. The reason behind this is to avoid a possible overload of the semantic model.

The semantic model needs concrete information to handle SPARQL queries. This information is referred to the relations existing between the different entities. However, some extra information such as, for example, the comments or opinions provided by the user is not stored in the semantic model. Post-Via only stores a reference which allows us to know if a given comment has been introduced.

3.2 Semantic Model

The main aim of the semantic model of Post-Via project is the storage of the information and data that Post-Via handles. The use of semantic infrastructures allows querying the information using SPARQL queries. The ontological architecture of the semantic component is depicted in Figure 2.

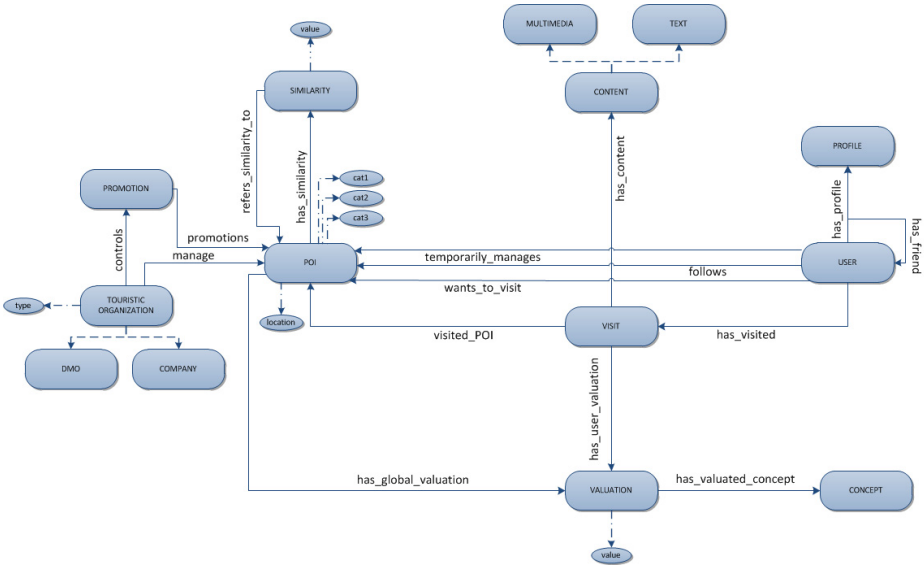

Fig. 2. Conceptual Semantic Model

In what follows the conceptual semantic models of Post-Via platform are explained:

- **User:** This entity represents tourist. Each tourist registered in the platform will be identified by an instance in the ontological model.
- **Profile:** Each user can have several (1-n) profiles. The profile class represents each possible profile existing in the platform. A profile defines the set of preferences for a tourist. Profile allows making recommendations between users based on their profiles. For instance, given a profile which reflects that the user likes some kind of restaurants, through the use of the platform it is possible to make recommendations to other users with similar preferences.
- **Visit:** This entity represents the visit that a concrete user has made on a concrete time and place. When a user visits a given POI (Point of Interest), a new instance of visit is created to store all the information related to the visit.
- **Valuation:** This entity represents the valuation of a visit. It can make reference to a concrete visit made by the user, or to the global valuation of a POI (calculated based on the valuation of the users). The instances of this entity present an attribute (value) to establish the weight of the valuation.
- **Concept:** This entity represents the concept that the user has valuated. It is also used by the global valuation. The concept can make reference to several things such as accommodation, cleanliness, food, etc.
- **POI:** It represents a concrete point of interest.
- **Similarity:** This entity represents the similarity which exists between several POIs. The instances of this entity present an attribute (value) to establish the similarity level.
- **Content:** This entity makes reference to the content which can be associated to a concrete visit (multimedia: pictures, videos, audio, etc...) or text (mainly comments).
- **Touristic Organization:** This entity is used to make reference to the organization which is in charge of the management of a given POI. It is mainly divided in two sub elements: private companies or DMO (Destination Management Organization).
- **Promotion:** This entity represents the promotions offered by the POIs. These promotions are managed by touristic organizations.

The different relations, which have been included in the semantic model of Post-Via, are presented in Table 1.

Table 1. Relations of the semantic model

Relation	Domain	Range	Inverse Relation
has_profile	User	Profile	is_profile_of
has_friend	User	User	is_friend_of
has_visited	User	Visit	was_done_by
has_user_valuation	Visit	Valuation	makes_reference_to
has_global_valuation	POI	Valuation	is_global_valuation_of
has_valuated_concept	Valuation	Concept	is_valuated_in

Table 1. (*Continued*)

visited_POI	Visit	POI	was_visited_in
has_similarity	POI	Similarity	refers_similarity_to
promotes	Promotion	POI	is_promoted_by
manages	Touristic Organization	POI	is_managed_by
controls	Touristic Organization	Promotion	is_controlled_by
follows	User	POI	is_followed_by
has_content	Visit	Content	is_content_of
has_multimedia_content	Visit	Multimedia	is_multimedia_content_of
has_text_content	Visit	Text	is_text_content_of
temporarily_manages	User	POI	is_temporarily_managed_by
wants_to_visit	User	POI	will_be_visited_by

The explanation of each relation is as follows:

- **has_profile:** This relation is used to establish a relation between a concrete user and one or more profiles. As explained before, the idea is to provide the system with the ability of querying the model in order to know possible associations or relations between users based on their similarities using their profiles. It is a non-functional relation because one user can present several profiles.
- **has_friend:** This relation is used to model a friendship link between two users. This relation allows knowing which users are friends. The aim of this relation is to create recommendation profiles based on several parameters such as friendship. For the sake of simplification, authors decided to use a new relation instead of using existing approaches such as Friend of a Friend (FOAF). It is a non-functional relation because one user can have several friends.
- **has_visited:** This relation is used to model a relationship between a user and his or her visits. It is a non-functional relation because one user can made several visits.
- **has_user_valuation:** This relation is used to perform a valuation on a concrete visit. It models a relation between a concrete visit and a concrete instance of valuation type. At the same time, the valuation will be related with a concept as explained in the relation *has_valuated_concept*. It is a non-functional relation because each visit has several valuations which cover the different concepts that can be evaluated.
- **has_global_valuation:** This relation is used to model a relation between a concrete POI and a valuation instance. Thus, it's possible to have a global valuation about a concrete POI based on the individual valuations of the users. It is a non-functional relation because a POI can have several valuation instances.
- **has_valuated_concept:** This relation is used to know which concept has been evaluated on a concrete "valuation" instance. Each POI has several

items to valuate (e.g. in a hotel a given user can evaluate the quality of the service, comfort, cleanliness, etc. meanwhile, for instance, a restaurant the quality of the food can be assessed). Thus, it is necessary to establish the concept which has been valuated. It is a functional relation because a valuation can make reference only to a concrete concept. This is because the valuation contains a numerical value.

- **visited_POI:** This relation is used to establish, on a concrete visit, which POI has been visited. Given that the relations between POIs and visits are unary, this relation is functional.
- **has_similarity:** This relation is used to set the similarity between two POIs. Thus, it is possible to know if two POIs are similar and how similar they are (based on the similarity level). With this information it is possible to make recommendations to the users. It is a non-functional relation because a POI can be similar to several.
- **promotions:** This relation is used to establish the relation between a concrete promotion, created or managed by a touristic organization, and the POI affected by this promotion. It is a non-functional relation because a promotion can affect several POIs.
- **manages**: This relation is used to establish a relation between a touristic organization and a POI. It is a non-functional relation because a touristic organization can manage several POIs.
- **controls:** This relation is used to establish a relation between a touristic organization and a promotion. It is a non-functional relation because a touristic organization can control several promotions.
- **has_content:** This relation is used to establish a relation between a visit and a content. It is a non-functional relation because a visit can have several contents.
- **has_multimedia_content:** This relation is used to establish a relation between a visit and a multimedia content. It is a non-functional relation because a visit can have several multimedia contents. This relation is sub property of *has_content* and hence it is not depicted in the diagram.
- **has_text_content:** This relation is used to establish a relation between a visit and a text content. It is a non-functional relation because a visit can have several text contents. This relation is sub property of *has_content* and for hence it is not depicted in the diagram.
- **temporarily_manages:** This relation is used to establish a relation between a user and a POI. With this relation we can know which POIs were created and are currently managed by a user. When a user adds a POI in Post-Via, the user is the manager of the POI until a Touristic Organization takes the control of it.
- **wants_to_visit:** This relation is used to establish a relation between a user and a POI. It is a non-functional relation because a user has the intention of visit several POIs.

Table 2 presents data properties of the semantic model. Special attention should be paid to “id” property. This property contains the ID, which represents a concrete instance in the semantic model. With the ID of the instance it is possible to query the relational database in order to obtain more information if needed.

Table 2. Data properties of the semantic model

Property	Domain	Range
type	Touristic Organization	Literal
value	Valuation Similarity	int
location	POI	Literal
id	Thing	Literal
description	Similarity	Literal
cat1	POI	Literal
cat2	POI	Literal
cat3	POI	Literal

To conclude with the description of the model, Figure 3 provides a representation of the semantic model painted with OntoGraf plugin of Protégé tool.

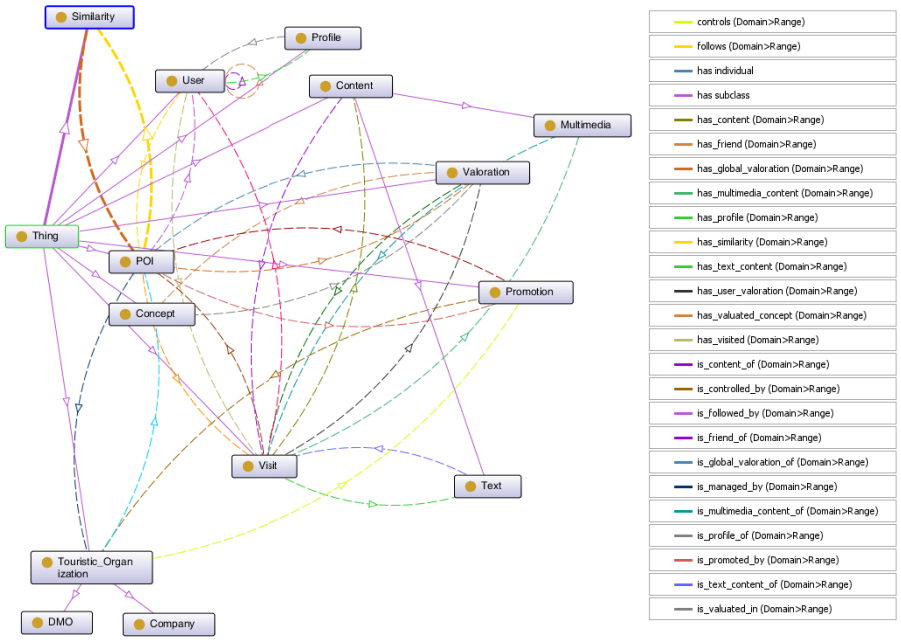

Fig. 3. OntoGraf representation of the semantic model

3.3 Accessing the Model

The access to the semantic model can be performed using several ways. Depending on the operation needed (store or retrieve), a concrete solution is adopted. Thus, in order to store information in the semantic model, authors have chosen Jena API as

main framework to load the ontology model and store the data. The access to semantic model and relational database is handled by a middleware that manages the dealing and storage of information in both persistence mechanisms, using Jena API to access semantic model.

On the other hand, in query issues, two main options are available for semantic frameworks. The first one consists on the use of Jena API. The main problem of this option is that it is slower and more difficult to implement because it requires knowing which exact classes and instances are you going to need. The second option, which is the one implemented in Post-Via, is the use of SPARQL. Once Post-Via requires information about the model, a middle interface is executed. This interface receives the information required and is in charge of generating the appropriate SPARQL query to access the semantic model. Most of the queries are fixed and, for hence, the associated SPARQL query is static. In those cases where the query is dynamic, the interface generates the SPARQL associated to the query asked by the interface. However, it is important to remark that the interface of Post-Via platform has been developed in such a way that it is not possible to process any type of query. For this reason, the numbers of queries that can be done against the semantic model are limited. The following snippets depict a small example about a typical query which can be made against the semantic model:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX pv: <http://127.0.0.1/postvia.owl#>
SELECT *
WHERE {
?u pv:has_visited ?v .
?v pv:visited_POI ?p .
}
```

Snippet 1. SPARQL Query to get users and visits

In Snippet 1 the SPARQL query which obtains all the visits made by all the users of the platform is showed. It returns the instance which represents the visit and the instance which represents the user.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX pv: <http://127.0.0.1/postvia.owl#>
SELECT ?v ?p
WHERE {
?u pv:has_visited ?v .
?v pv:visited_POI ?p .
FILTER regex(str(?u), "US001")
}
```

Snippet 2. SPARQL Query to get POIs of visits of a concrete user

Snippet 2 shows the SPARQL query which obtains all the visits (and the POI associated to each visit) of a concrete user (US001).

4 Conclusions and Future Work

In new scenarios in which the internet has deeply changed tourism services provision patterns, tourism organizations behaviour is changing to wisely adapt to these new circumstances. Post-Via framework provides a new platform built to help tourism organizations to attract tourists to places they already have visited before. Based on a set of cutting edge technologies (geographical information systems, recommender systems, customer relationship management, social networks, mobility and semantic technologies), Post-Via represents a novel approach to achieve tourism loyalty by means of allowing the user to have a platform that assists him once his trip has finished.

Future research will be focused on the development of DL axioms or rules which allows the execution of inference engines over the semantic model to infer useful knowledge based on the descriptions of the domain. Future works also will be centered on the testing and discussion of the platform along with its comparison to other systems similar in terms of technology, aims and functionalities.

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