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Designing an Ontology to Describe Ecological Cycling Routes within the Province of Tungurahua

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*Ontology****; Tourism, Tourism routes, RDF, RDFS, OWL.***

Abstract

Tourism, a significant industry worldwide, has allowed for economic, social, and cultural development in rural areas because of all the advantages it offers to tourists. Ecuador is a country that presents a wide range of alternatives in the tourist field allowing a massive tourist influx to many of its destinations such as indigenous communities, natural reserves, and tourist, ecological, and volcanic routes. Most importantly, Ecuador encourages the conservation of the diversity resulting from such influx. The objective of this research is to design an ontology which facilitates a description of the bicycle tourist routes in the province of Tungurahua, and specifically in the city of Ambato. Apart from route descriptions, this ontology gives information about the flora and fauna and places of interest such as inns, hotels, and restaurants that can be found along this route. This ontology was developed based on the application and enforcement of semantic web technologies. That being said, all the described information is attached to an RDF vocabulary and it can be accessed using SPARQL. Therefore, information that is semantically described in an organized and standardized manner is available in order to allow for interoperability with other existing data sources. As for the development of the ontology, the methodology used was an open code software known as "protégé". The OWL (Ontology Web Language) was also used as marked language and RDFS for the description of the employed vocabulary.

1. Introduction

Tourism is a field in constant development. Therefore, the appearance of new technologies and specifically that of the semantic web have had a great impact among tourist agents and each and every one of its processes (Barta, Feilmayr, Pro¨ ll, Gru¨ n, & Werthner, 2009). Affected was also the quality of information on the web and giving place to the appearance of the semantic web. This technology gives machines a level of understanding on the web to know what the user needs in an easy and natural way. The huge amount of information that is related to the tourist industry, the decentralization and lack of standardization in this field hinders the labor of the agents or tourist services when offering the users updated information on demand.

The technologies of information and communication based on semantic web have had an important and fundamental role in the field, promoting complex products that are able to satisfy the demand of the different types of travelers regardless of their preferences (Zhong, Zhu, Li, & Yu, 2002). Thus, it is necessary to examine various sources of information before offering the traveler a route proposal, product or tourist destination, and lists of cultural, ancestral or leisure activities (Niemann, Mochol, & Tolksdorf, 2008).

Seen from this perspective, all the information available in big data stores on the web have increased and have become decentralized, hence making it indispensable to take the challenge of locating, administrating, processing and integrating all that amount of information that is considered relevant in this area (Zavarella, Tanev, Steinberger,

& Van der Goot, 2015). Nevertheless, it is important to consider that this information has been generated without any control or organization. As a result, it has become necessary to develop a kind of technology which allows the processing of all these contents from the semantic point of view for its classification and proper use (Flügge & Tourtchaninova, 2004).

In accordance with all the above, semantic web is defined asan important area in the field of web technologies which gives a very well-defined meaning to information (Gontier, 2015), allowing computers to acquire a level of simple understanding of the web (Carroll, et al., 2004). At the same time, it performs activities given by the user naturally. This technology provides the capability to integrate all the diverse data sources and get more specific and precise search results as well as minimize time and resources since there is an automation of very complex tasks for human beings (Brunner, et al., 2007).

2. State of Art

A tourist route is characterized by a promotion of new knowledge in the area, with the purpose of gaining tourism attention as the place develops due to the multiple ways that search to venture inside a determined market (Araújo & Fraiz, 2017). That being said, and as time goes by, different types of tourism arise. Despite being pleasant in nature, these types are declared necessary mechanisms. As a result, tourist bicycle routes emerge as an entertaining alternative. Moreover, when a tourist takes a tour and analyzes connections and areas of tourist fluxes, cultural interest arises and natural spaces and population increase (Fernández, 2015). This creates an attachment between the individual/tourist and the experiences recreational activities provide since they are performed on occasions, during vacations, free time or simply as routine. When taking a bicycle route, the tourist chooses a more sensitive experience and appreciates the environment due to direct contact with it without any vehicular access. In order to be exposed to climate conditions and nature, tourist regions propose, besides maintaing a personal connection and tranquility, that riding a bicycle helps in capturing the rhythm and essence of life when a person goes through stress or tension (GonGonçalves, Corrêa, da Silva Carmo, & Toro, 2016).

Serra (2016), states that tourism on a bicycle is thought of or is categorized as inferior. However, in the future, this is expected to change since it does not only invigorate economy, but it is also respectful of the environment. Thus, this type of tourism results in a determined sector being compromised in offering high quality services. As the tourist has the opportunity of keeping direct contact with natural and cultural attractions, the visitor on a bicycle is a potential client of tourist places and hotels that takes this activity as a method/ route to a particular objective depending on the researcher and his/her ability to establish connections on different points such as on roads, mountains, paths (with or without vegetation). Needless to say, cycling facilitates a coexistence with the population that offers harmony, value, and respect for the place where the activity is being done.

The bicycle is a non - polluting mean of transport which promotes sustainable tourism with respectful habits towards the natural environment. It offers protection of local communities and its traditions as well as provides socio-economic benefits in the under-developed areas. That being said, cycle-tourism is becoming an important segment for opportunities of diversification and development (Moral, 2016). Taking tourist cycling routes provides the visitor with bigger access to the natural site due to easy access to places that do not have enough spaces for vehicles (Mrnjavac, Kovačić, & Topolšek, 2014). They also provide a method of organizing tourist servers in an improved way by using better signals, more information, and caring for the environment among other things. Saldanha, Fraga, & Peixoto de Sequeira Santos (2015) consider that in the Paquetá Island, in Rio de Janeiro, known as “The bicycle’s Island” has the implementation of cycle lanes with technological applications and mobile internet usage sources such as QR codes so that the tourist has the chance to find strategic locations when lost. As a result, the tourist becomes curious to practice cycle-tourism turning it into a tourist activity and another way of sightseeing. At the same time, it offers support for the tourist in finding a tourist route and other general aspects such as the duration, length, climate conditions, signs and orientation of the place. It makes clear connections with other interesting places and services near to the routes used.

On the other hand, a research held in Costa Rica states that a cycling lane is more accepted by tourists in natural places that are organized by certain tour operators which promote the activity such as the Arenal Volcano, Guanacaste, and the Atlantic zone with flora and fauna species which encourage cycling (Ledezma, 2016). Moreover, cycle-tourism has been taken as an alternative of development in many European countries where it has been taken as an option for people who know and value nature and the benefits that riding a bicycle offers. It is preferred because new ways of fighting consumerism are being found. This, exactly, is what happens in the Alicante Province where acceptable conditions have been established to make cycle-tourism as its duration, landscape, infrastructure and primary services cover the tourists’expectations. The place has a cyclist tradition which encourages practicing the activity (Soler, 2016).

According to Rodríguez (2016), cycling starts as a territorial sport or practice which is established by the geography or development of the place. Relating to a territory, it is a way of interaction with the landscape, sports, flora and

fauna where the person experiments security with a controlled effort as it depends on the speed and rhythm of the bicycle and the user. The cycling lane is part of an activity that requires will, capability, a good mood and physical state to perform within the grounds of a marked tourist route. With this modality, the tourist appreciates cycling from another point of view where all the aspects are related with the route in a cycle or chain circuit because as the route is taken and completed the environment will be made familiar as normally a cycle tourist practices it to know themselves and nature.

In the tourist field, and along the years, it become possible to develop a large number of data catalogues and at the same time taxonomies which facilitate the information processing of all the tourist agents, knowing that its use has been internal and without implementing standards or rules that govern them (Berners, 2011). Inside the ICT, diverse tourist ontologies have been developed, both, public and private. Considering that many of these have an advanced maturity level that represent not only generic aspects in the tourist field, but also subdomains that are even more specific than the ones which describe more concrete sceneries as this ontologythat is considered in the local environment (Srinivas & Akerkar, 2008).

3. Methodology

3.1. Semantic modeling of Ontology

Gómez and Suárez offer methodological guidelines based on scenarios that are used to model and develop ontologies (2009). In their guidelines they describe a series of 9 scenarios in which an ontology can be modeled. In this paper, we select scenario 1, which allows us to specify the requirements to be fulfilled by the ontology and scenario 3 for the reuse of ontological and existing resources.

The developed ontology is small in size and punctual within the domain it represents.

3.1.1. Domain Analysis

In the development of ontologies, the first step is to identify the domain of the information to be represented. It is most appropriate to draw on expert knowledge, taking advantage of existing categorizations or classifications.

For the description of ecological touristic routes, we use the classifications that the Book "Manual of Hiking" and the web page WikiLoc provide. All this is done with the purpose of making a correct definition of the classes and properties that ontology must have in order to describe fully and correctly the selected domain.

3.1.2. Requirement Definitions

The purpose of constructing this ontology is to test a model of consensual knowledge for the description of ecological touristic routes. It can be used by the general public that wishes to know the ecological routes that are there in Tungurahua, specifically in Ambato.

Two non-functional requirements are defined by the ontology.

- Ontology must be modular, which means that it allows the addition of new classes, properties and reuse.
- Ontology must be developed in English, as this is the language in which the vast majority of ontologies are developed.

Potential final ontology users:

- Software developers
- Government organizations
- Touristic providers

Potential uses:

- Make available to software developers a semantic database with routes and tourist sites that can be used in web or mobile applications.
- Search for alternative routes with greater diversity of flora and fauna in its path.

The markup language selected for the implementation of the ontology is OWL which has 3 sublanguages from which OWL Lite has been selected.

The selection of ontology vocabularies has been developed following the recommendations made by the W3C as best practices for the vocabularies selection. To find these vocabularies we use an open vocabulary searcher called "Linked Open Vocabularies" LOV.

The first step is to define a conceptual model of the ontology to be developed using natural language to be able to identify the classes and their relationships between properties or other classes.

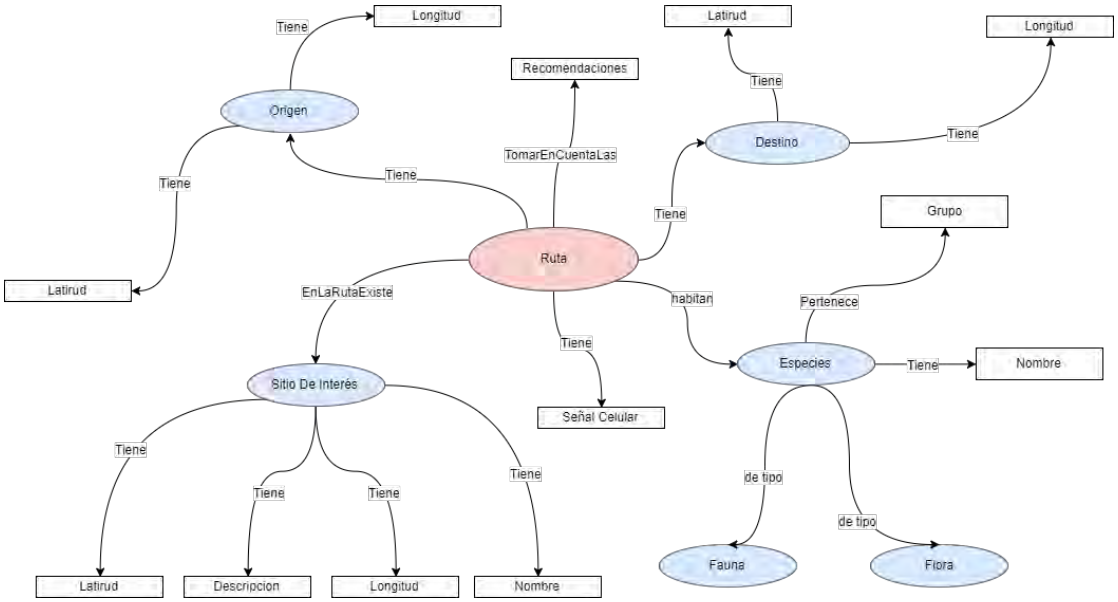

Figure 1 Conceptual model on work domain

3.2. Definition of ontology vocabulary

Following the work of Piedra, Cadme, and Chicaiza, when modeling the domain it requires the following activities and tasks (2014).

3.3. Ontological resources re-use

One of the means to collaborate in the integration of resources within the web is the reuse of existing vocabularies. The vocabularies listed below are those that will be reused.

- RDF Schema, and OWL, to write the vocabulary.
- DBpedia ontology: this ontology is generated from the specifications created manually in the DBpedia Mappings Wiki. Each version of this ontology corresponds to a newer version of the DBpedia dataset that contains instance data extracted from different language versions of Wikipedia.
- Bio Top: a high-level ontology that provides definitions for key biomedical entities as a basic vocabulary to unambiguously describe the facts in this area.
- Schema: this vocabulary will reuse the concept to model the place class, as well as data properties and relationships between classes.
- Geo: a basic RDF vocabulary that offers the Semantic Web community a namespace to represent latitude, longitude, and other information about things, using WGS84 as reference data.
- FOAF: vocabulary developed to represent people with their attributes and relationships to other concepts, especially organizations.
- Npg: a formal vocabulary that provides definitions for key concepts of interest, which helps to publish content in education and science.
- Uta Open Vocabulary: created specifically for this work, it makes it possible to describe those attributes, properties and entities that have not been modeled previously in other vocabularies on the web.

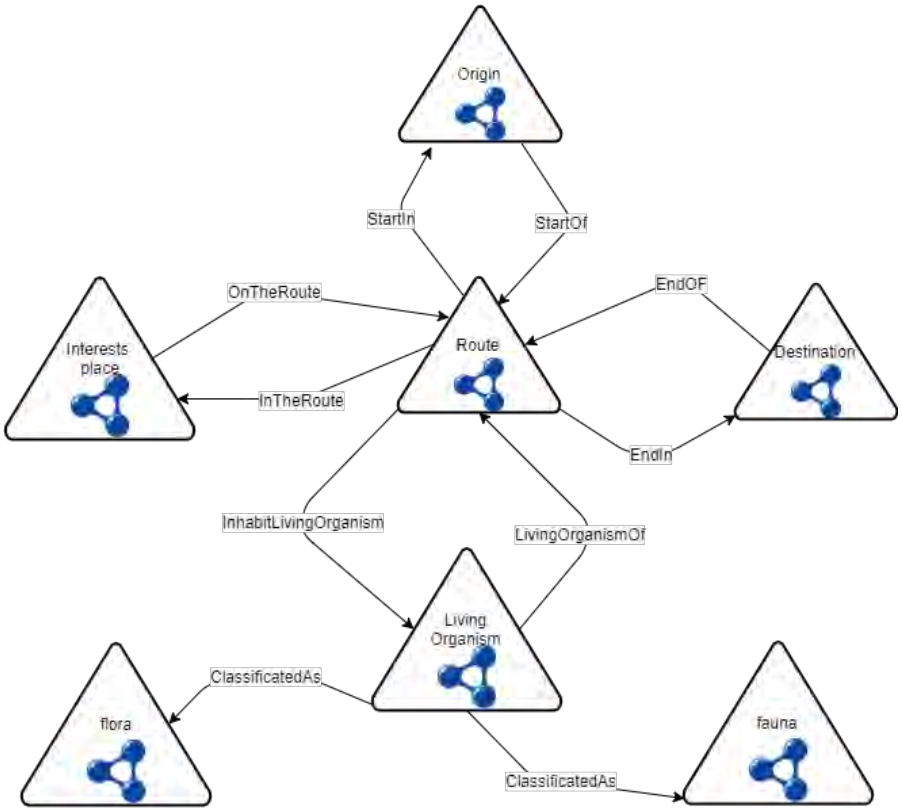

Figure 2 Approximation of the conceptual model description and it must be expressed in RDF language, so it can be continued in the linked data cloud.

Figure 3 shows the model that represents the ecological tourist routes in Ambato. For this domino model, classes of vocabularies like scheme, foaf, dbpedia-owl npg, fgeo were used. These languages are described in the classes and relationships. Ontology.

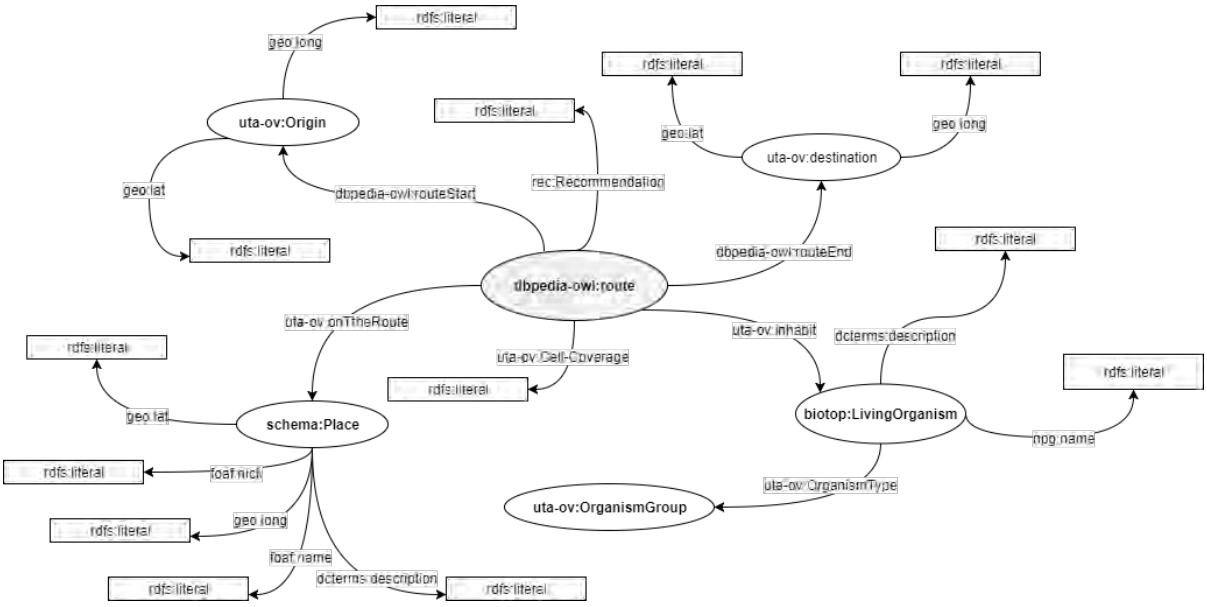

Figure 1 Semantic model of data to describe touristic routes in Ambato

Table 1. Class of ecological tourist routes

CLASS	DESCRIPTION
Route	Represents the route that exists from a place of origin to a destination
Origin	Represents the starting point or beginning of the route leading to the selected destination.
Destination	Represents the end of the route
Place	It represents all places of interest that can be found along a route like parks, reservations or other places of interest for the visitors.
Living Organism	It represents all living organisms that live along a route, highlighting the biodiversity in the area where the route is.
Organism Group	It represents the group to which the living organisms that inhabit the route belong, whether they are within the flora and fauna of the area.

To develop the ontology, we used Protégé, which is a tool that allows us to represent our model in an OWL and RDF language. It will later provide an RDFS for the conversion of triplets.

When using Protégé, you create the Route, Place, Origin, Destination, Living Organism, and Organism Group classes. Similarly, data properties have been created to describe properties of classes. Object properties have also been created and they represent the relationships between the modeled entities.

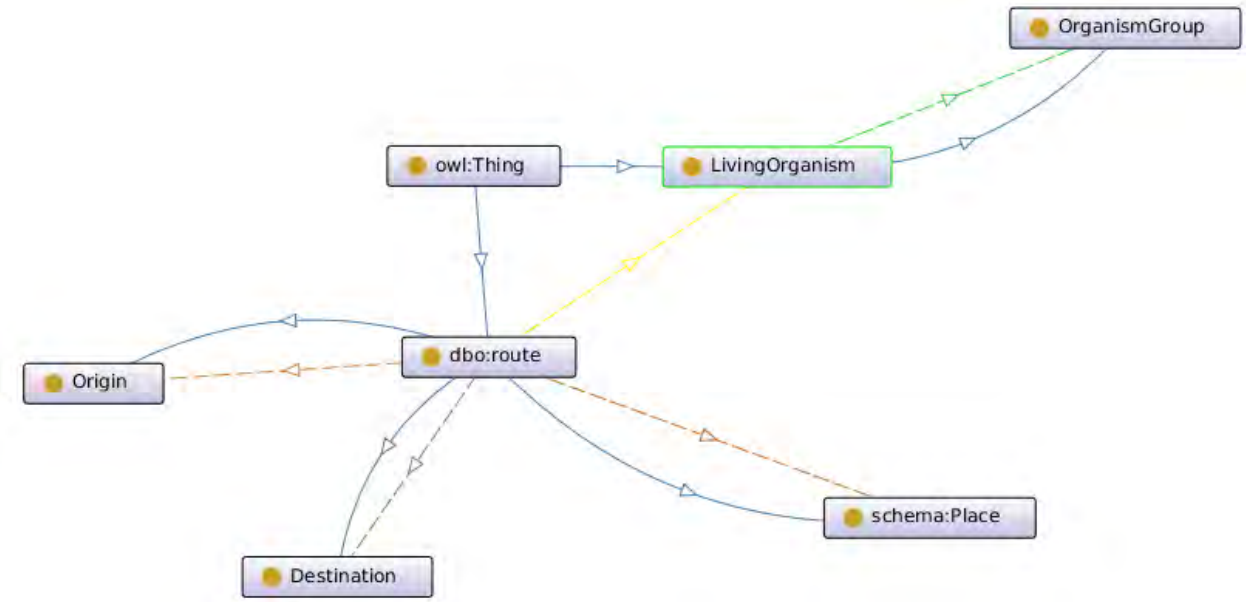

Figure 2 ontological model created on Protégé

With this first approximation, the ontological model retaining the whole cycle for the semantic description of the tourist routes in the city of Ambato is obtained, which will form the basis for the process of publication of tourist information in the linked data cloud.

4. Conclusion

The research shows the development of an ontology that identifies the tourist routes in the city of Ambato by natural and landscape spaces, from the initial phase of identification of the information obtained within the research to the tests of the concept developed in an instance within the ontology.

The use of conceptual stability focused on the education sector and the integration of all the information that is possessed of the city of Ambato in the tourism sector once reliability and precision of the results are granted.

Through the development of ontology, one can appreciate the level of maturity of the technologies that are part of the semantic web and the different programming languages that are used for its development through different types of properties.

For future work, we put a test ontology alongside the introduction of the basic information obtained in the length of this research. Outside of the conceptual space, shown in this article, we want to integrate all the requirements into a global project to show its real usefulness by providing the traveler with tourist routes based on their characteristics or preferences when traveling.

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