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# Software for studying and enhancing educational uses of geospatial semantics and data

T. Nodenot\*, C. Sallaberry and M. Gaio  
*LIUPPA Laboratory, Pau University, France*

## Abstract

Geographically related queries form nearly one fifth of all queries submitted to the Excite search engine and the most frequently occurring terms are names of places. Our contribution focuses on digital libraries and extends the basic services of existing Library Management Systems to include new ones that are dedicated to geographic information extraction, retrieval and visualization. We report on the experimentation of these services in order to manage geospatial data within touristic and educational software.

## Keywords

Geography education, distant places and itineraries, geographic information retrieval and visualization, learning environments

## Building a Geospatial Web for Tourism and Education: Technical Steps

We consider the Geospatial Web as an integrated collection of geographically related Web services and data that support the use of geographical information in a range of domain applications (Lake et al. 2007). Geographical Information (GI) may be distributed across various expression modes, such as text, maps and tables, involving spatial, temporal and thematic aspects, for instance, the sentence “churches of the XVth Century at about 8 miles in the South of Paris”.

In our study, we use adaptable core models (Gaio et al. 2008) to support the semantic processes required for GI automated indexing, and even GI retrieval processes. To this end, we have devised three GI automatic tagging chains within textual documents. The “spatial chain” produces an index where each Spatial Feature (SF) is associated with one or more geometries. Similarly, the “temporal chain” associates Temporal Features (TF) to one or more temporal intervals and the “thematic chain” is based on well-known statistical criteria (terms frequency). Advanced functions approximate relative SFs such as “near Paris” or “at about 10 km in the south of Paris” or even “between Paris and Versailles”. In this way, the interpretation of the semantics of geographical information leads to the building of specific spatial, temporal and thematic indexes (Gaio et al. 2008). These indexes can be important resources for touristic and educational applications.

Our first experiment was a touristic application (figure 1) that provided end-users with different views: a query view (❶), a cartographic view (❷) and a textual view (❸), suitable for retrieving documents from a geographical query. This application automatically localizes the places mentioned within the retrieved documents (figure 1, view ❷) and by clicking on the icons on the map, the user can access paragraphs of the corresponding documents (figure 1, view ❸).

This application is also of interest for geography courses, so we decided to further investigate the potential educational uses of the different indexes that we were able to automatically produce from our documents. We particularly focused on educational scenarios that address the users’ abilities to recognize and to interpret specific localized documents called “travel stories”.

We have thus extended our available toolset with the capability of automatic interpretation of the semantics of itineraries embedded in such travel stories (Loustau et al., 2008): we

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\* Corresponding author. LIUPPA Laboratory (IUT de Bayonne), 2 allée du Parc Montaury, 64600 Anglet, France.  
Email: Thierry.Nodenot@iutbayonne.univ-pau.fr

designed some "transducers" enabling the software to infer the origin, the destination and the modality for each movement verb appearing in a text. Subsequently, this information is used to discover the itineraries followed and to index them for further use. A web interface for this toolset is available at <http://www.clubdefrance.fr/PIIRv2/index2.php>. To test the PIIR toolset, one must key-in an itinerary in French e.g. "*Je pars du Sud de Bordeaux et chemin faisant, j'arrive à Bayonne où je passe quelques jours. Ensuite, je vais à Tarbes qui ressemble à Montauban, ceci avant de rejoindre Caunterets*" (the English translation is : "*I left the southern part of Bordeaux and, on my way, I reached the city of Bayonne where I spent few days. Then, I moved to Tarbes that looks like the city of Montauban, and I finished my trip in Caunterets*".

### Enhancing Educational Uses of the Geospatial Web

To enhance the educational use of the Geospatial Web, we combined cartographic information related to textual representations, as in ViTra, WordsEye, Hyperpaysage projects (Maaß et al. 1993; Coyne et al., 2001; Sanchez et al., 2006).

We thus developed different applications on the Internet, to help users discover places and itineraries embedded in textual documents. Figure 1 is a snapshot of an application that can help users locate places evoked from within cultural heritage corpora, while Figure 2 is a snapshot of an application focusing on the itineraries evoked from travel stories. Figure 2 presents an educational application example that allows learners to synchronize a text (Figure 2 - view ②) with cartographic (③), temporal (⑤) and thematic (④) views. The snapshot shows that on the 12<sup>th</sup> of July (⑤), the part of the text in dark grey (②) deals with activities that took place in the region depicted on the map (③), while the main theme discussed in this part of the text deals with the theme of plants and nature appearing in dark grey in the thematic view (④).

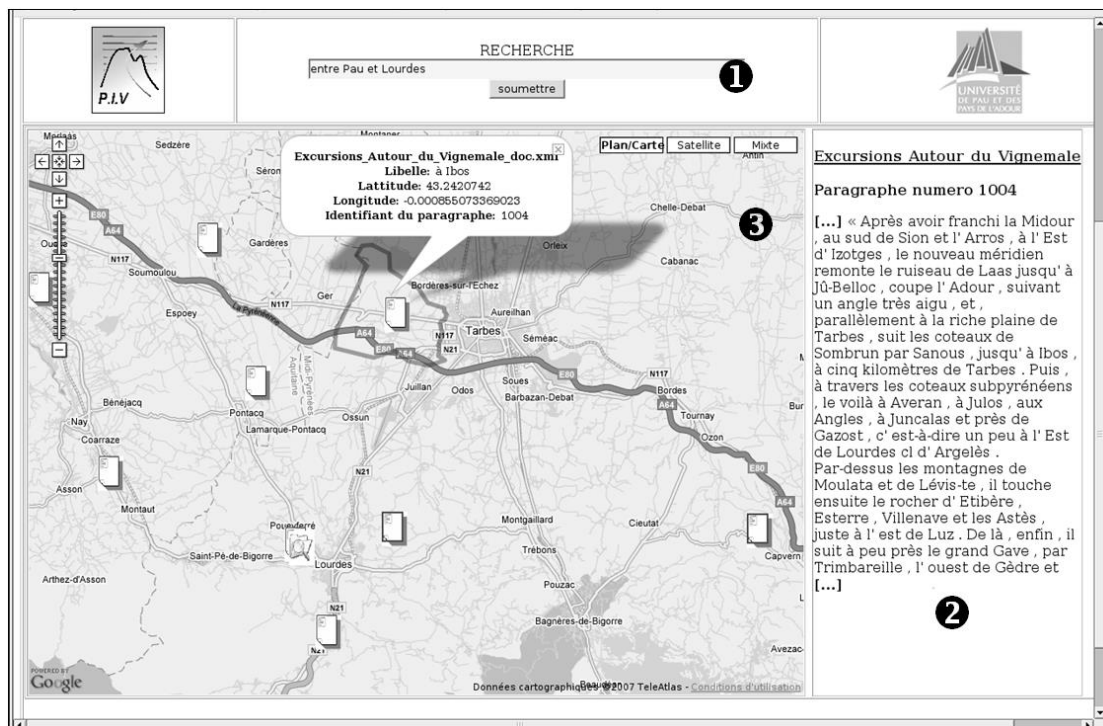


Figure 1. A touristic application providing users with different views: a query view (①), a cartographic view (③) and a text view (②), allowing the retrieval of documents from a geographical query (e.g. "*I look for texts related to places located between Pau and Lourdes*").

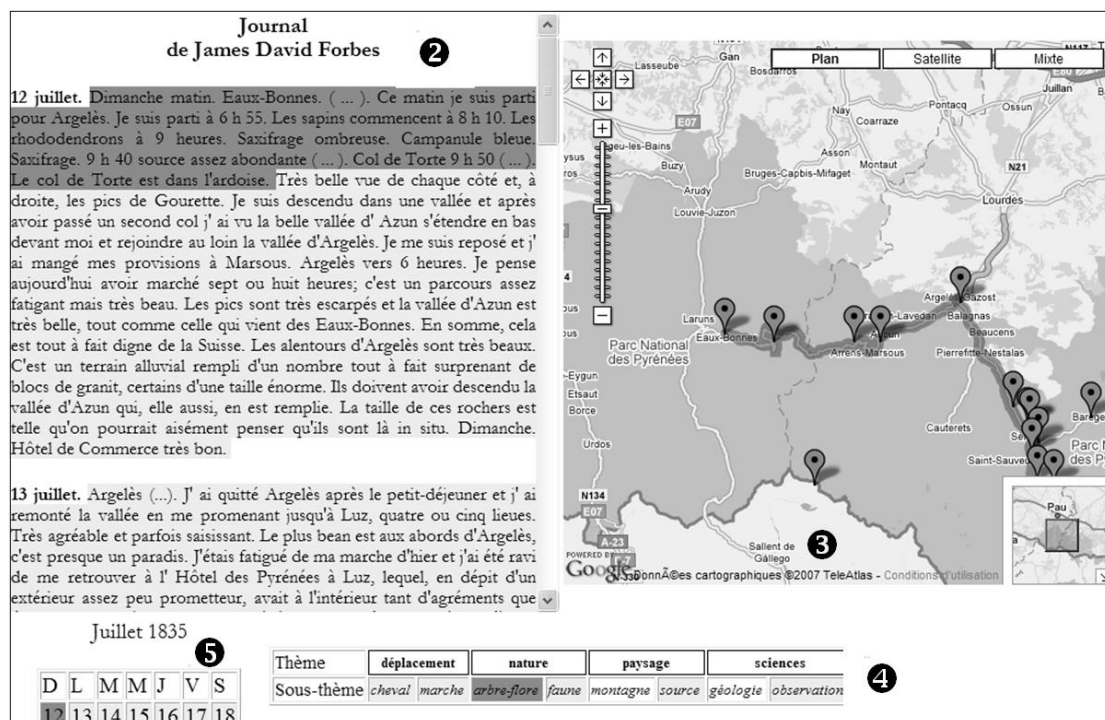


Figure 2. An educational application example enabling learners to study a text with synchronized cartographic, temporal and thematic views (3, 5, 4 respectively).

The latter application makes use of an index representing the georeferenced itinerary that the PIIR toolset can automatically extract from a particular travel story. From such indexes, we develop applications capable of intelligently monitoring learners who are engaged in problem solving activities to reach a better spatial understanding of places, landmarks, trails, etc. reported in the texts under study.

We address these design challenges from an end-user perspective. Our goal is to provide teachers with specialized tools that facilitate the production of educational applications like those depicted in figures 1 and 2.

To this end, we advocate a component-based approach. The analysis of both illustrated applications shows that they share some user-interface characteristics. These applications' interfaces are decomposed into different parts that in turn give access to different components: a query (see component 1 in Figure 1), a text (see component 2 in both figures), a map (see component 3 in both figures), a thematic browser (see component 4 in figure 2) and a calendar (see component 5 in figure 2). Through this component-based approach, designing an educational application consists in: a) identifying the components that fit the designer's teaching objectives and b) using a specialized editor to decide which interactions each particular component should offer in the educational process (Etcheverry et al, 2008). Such editors can be used by a teacher without advanced computer skills to design interactive maps and interactive texts. When editing a travel story, teachers will see icons and polylines on the map representing spatial information (places, trails ...) associated with the accompanying textual document. Preliminary experiments with 11 years old learners showed that such interactive maps generated by our editors are useful teaching aids in tutorials of general or touristic geography.

## Conclusion and Future Works

Our works promote geographic automatic tagging chains which are dedicated to unstructured textual cultural heritage libraries. These chains produce various indexes pointing out spatial and temporal information as well as higher level information like itineraries. Such

information can be automatically retrieved and used by teachers to specify educational interactions, with the aid of specialized editors. Future directions will aim to complement this semantic approach with statistically validated functionalities, in order to establish general retrieval processes combining spatial, temporal and thematic querying criteria.

These improvements of our toolset will enhance the functionalities of our available components for the benefit of educators and geographers alike.

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