Generation of web-based GIS applications through the reuse of software artefacts*

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Abstract. This demo shows the automatic generation of different web-based geographic information systems using a tool based on software product lines engineering. These systems are variant regarding the data domain they can manage and the functionalities they provide. Although the products are different, the set of assets that implement the GIS-related functionalities is the same. These assets are assembled together by our tool depending on the particular requirements of each products. In the demo, we show the behaviour of both the tool generating the products and the products themselves.

Keywords: web-based geographic information systems, software product lines engineering, software engineering

1 Introduction

Developing web-based geographic information systems (GIS) is a costly task. In addition to the traditional intricacy of designing and implementing any information system, the geographic component adds an extra level of difficulty: the system has to handle a different kind of data with its own functionality that is specially complex if we compare it to alphanumeric data processing.

The current standardization of the domain makes the design of GIS-related software artefacts easier than ever. In fact, it is possible to define all the data and procedures required by a particular web-based GIS product using a domain-specific model, develop reusable software artefacts that implement this model, and define and define and build web-based GIS products by specifiying an instance of the model and combining the software artefacts accordingly. There are some previous works in this direction: [4] describes a tool which generates a web-based GIS with a fixed set of features adapted to a particular data domain;

* This work has been funded by MINECO (PGE & FEDER) [TIN2016-78011-C4-1-R, TIN2016-77158-C4-3-R, TIN2015-69951-R]; CDTI and MINECO [Ref. IDI-20141259, Ref. ITC-20151305, Ref. ITC-20151247]; Xunta de Galicia [ED431C 2017/58].

instead, [1] shows a set of web-based GIS prodcuts with some variable features, but sharing all of them the same data domain. Both approaches share one point: they focus on web applications, which gives us an idea of how important are web-based GIS nowadays.

We created a tool that can generate web-based GIS products where both the data domain and the functionalities are variant. This tool is based on a well-known methodology on software engineering: software product line engineering (SPLE). This methodology is based on reuse strategies and mass-customization, aiming to achieve the automatic generation of software in a industrial way. SPLE has been applied to many domains to reduce the cost and time to market of new software applications and, at the same time, to improve the quality of their code. In [3], we defined a SPLE for the generation of web-based GIS using a methodological process that includes the analysis of existing GIS applications and architectures, the standards defined in this domain and the knowledge of a software company with a certain grade of experience.

In this demo, we show the tool that we designed and implemented a tool that satisfies the requirements defined in [3] and that it is able to generate web-based GIS products having the most common functionalities for these systems with different levels of complexity. The users of our tool are also able to specify the data model that the new application has to handle. Therefore, we can create web-based GIS applications for any data domain. The technical description of this tool is described in [2].

2 Reusing software to generate GIS applications

In [3], we identified and described an exhaustive set of requirements and features for web-based GIS products. A table summarizing the requirements can be found as supplementary material[1]. Similarly, the full table of features that the Software Product Line platform must provide in order to is available as supplementary material[2]. Some of the features are standard for any web application, such as every feature related to *User Management*. The other features focus on providing functionalities common to web-based GIS-products existing in the market.

Our tool can create products that implement GIS functionalities over a particular data model schema. For example, the component to *import shapefiles* can be used both by an application that handles warehouse logistics or by one that manages geolocated sensors. Fig. 1 shows a screenshot of the component being use to import some *road* data into an application.

Another set of feature that our tool provides is *importation, visualization and management of raster* layers (see Fig. 2). Fig. 2a shows the *layer management* feature that can be used to change the layers present in the map viewer, to change their style or opacity, to centre the map in the bounding box of a layer, or to download the data of a layer. In Fig. 2b, the *map viewer* is shown with

[1] Web-based GIS requirements: `http://lbd.udc.es/webgis-spl/requirements.pdf`
[2] Web-based GIS feature list: `http://lbd.udc.es/webgis-spl/featurelist.pdf`

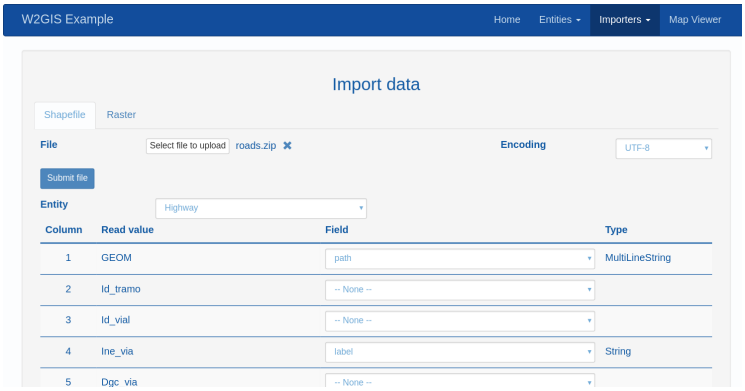
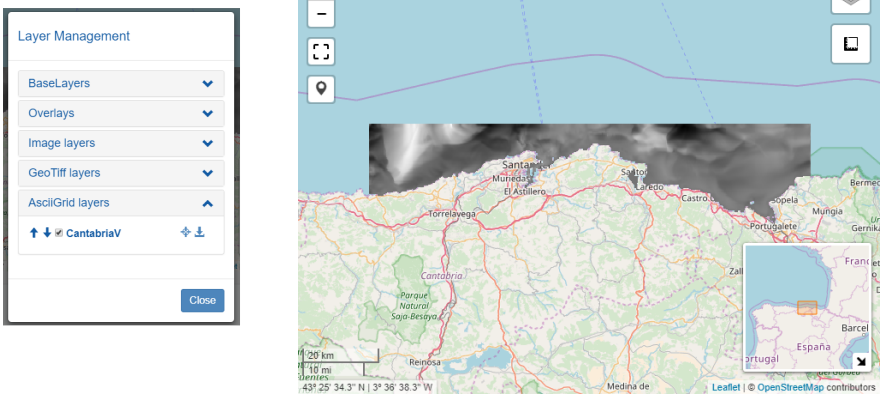


Fig. 1: Shapefile importation feature

a raster layer of the Cantabrian Sea loaded, with some tools such as *context information*, *user geolocation*, *zoom-to-window button* or *measure toolbox*.

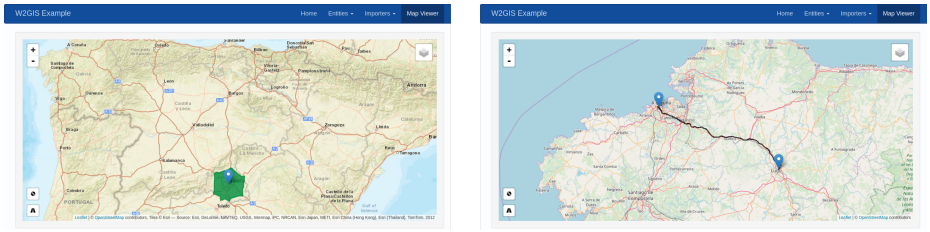


(a) Layer manager feature (b) Map with a imported raster

Fig. 2: Raster importation and viewing

Our tool is also able to generate products with some advanced features implemented, such as network tracing or route calculation. Specifically, we provide a REST service that can be called from our map viewer, using a simple interface, or from any other client application connected to the GIS. For example, we could calculate the places accessed from the centre of Madrid in a 30 minutes travel by car Fig. 3a or the route to go from Lugo to A Coruña Fig. 3b.

In Fig. 4 we show the *address geolocation* component that be used to compute the geographic coordinates of an address associated to an entity of the data



(a) Network tracing feature (b) Route calculation feature

Fig. 3: Connectivity related features

model. All the features described in this paper are some examples of the great grade of customization achievable with our tool.

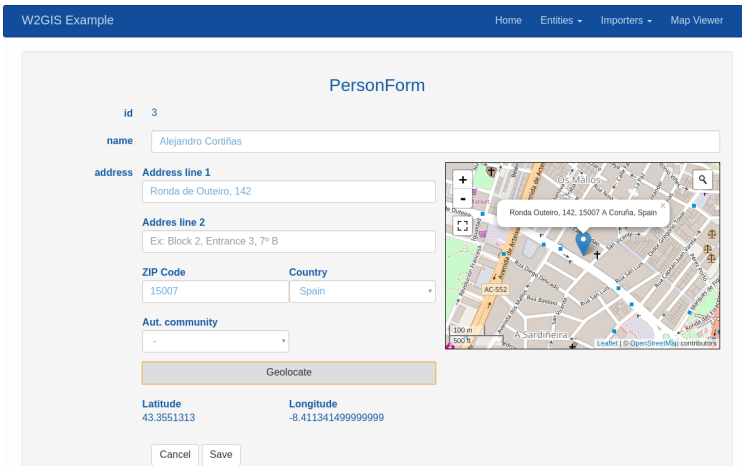


Fig. 4: Address geolocalization feature

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