GISELA: A WEB-BASED INTERFACE FOR A RISK MANAGEMENT GIS USING XML

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ABSTRACT

This paper presents the design and implementation of a web-based interface for a risk management GIS using XML and open standards. The analysis and visualization of geographic information in a distributed environment like Internet is essential nowadays. In this paper we will present how we are using XML to transfer and display geographic data. Several efforts have been done to translate the Geographic Markup Language (GML) [1] (an XML specification proposed by OpenGis [2]) to a 2D representation using SVG [3]. In this project we are also looking to translate GML documents into a 3D representation using X3D and VRML [4]. This representation is ideal because of the three-dimensional nature of geographic information. Another advantage of using VRML is the GeoVRML [4] extension, because we can generate geo-referenced three-dimensional models. We use XSLT stylesheets to transform the GML document into VRML. XSLT is the technology proposed by the W3C to translate XML documents. The work presented in this paper will be implemented on a proposal for a risk management GIS for the Popocatépetl volcano.

KEY WORDS

GIS, Visualization, GML, VRML, XSLT, Risk Management

1. INTRODUCTION

Authorities responsible of risk management identify and evaluate potential disasters to reduce loss and damage of people and properties [5]. Our proposal will support the decision making process for risk management and will describe a geo-spatial data model for this context. The work described in this paper will be implemented with the Popocatépetl volcano data where risk reduction is an essential activity. When the Popocatépetl volcano starts its activity, about 200,000 people distributed in 50 towns are in danger [6]. On Figure 1 we can see the risk areas associated to the volcano and the population affected. Visualization of geographic data allows the experts to analyze and evaluate different risk situations. Because risk management needs several authorities to have an opinion about the same phenomenon we are looking to support the analysis and visualization of this geographic information in a distributed environment.

The visualization in any Geographic Information System is a very important component, this task can be done by using several formats and services but in a distributed environment like Internet the use of a standard format is important. In this paper we will present the design and implementation of a web-based interface for a risk management GIS using XML and open standards.

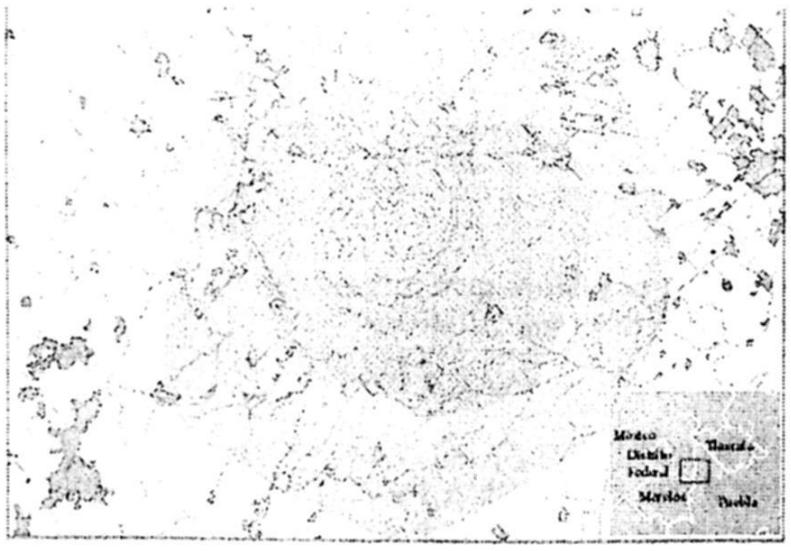

Figure 1. Risk Areas associated to the Popocatépetl volcano.

2. RELATED WORKS

The use of XML for distributed geographic information was presented on [7]. The prototype presented in this article describes how distributed databases, a mediator server and clients have been integrated using XML. The client, a Java applet received XML documents from geographic information integrated from diverse sources (OODB, Files, and RDB). The XML document contained geo-referenced information modeled after Oracle's GeoXML. This article mention several advantages of using XML, the independence of platform, the ease of use, the integration of descriptive and geographic

information and the validation of information using a DTD.

On [8] shows how to use XSLT stylesheets to transform a GML document into a 2D map with SVG. SVG is the Scalable Vector Graphic format, an XML proposal for vector data in two dimensions of the W3C [3]. The main advantage of using XSLT is that it is a standard to manipulate XML documents, and can be implemented by a client or by a server. The advantage of using SVG instead of an image format is that information from a SVG document is vector (instead of raster), so we can have multiple zooms, interaction and animation.

3. GISELA DESIGN

In a distributed environment, like Internet, information servers and user needs can have different configurations. For example, we can process data in one server and visualize it in another; we may also need information from several servers and process it on a client machine. XML is the ideal solution for these needs. Using GML we can represent geographic information, including geometric and descriptive data with XML. GML let us exchange and share data between different sources and servers. For data visualization we are working with XSLT to translate a GML document into HTML, SVG and X3D. We use HTML to present descriptive data, SVG for a 2D representation and X3D for 3D representation. Figure 2 shows this process.

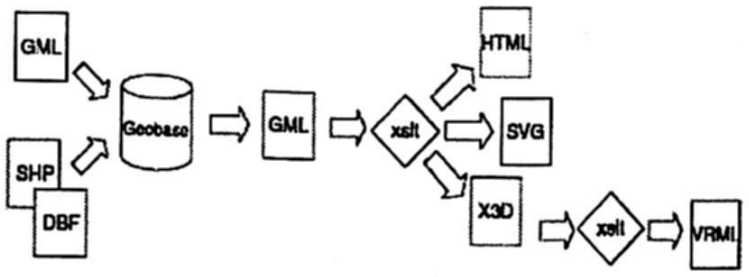

Figure 2. Gisela Design.

4. IMPLEMENTATION

Several tests have been made in the context of the Popocatépetl volcano. We acquire digital cartography of the zone consisting of roads, cities and towns, rivers, and terrain scale 1:20,000. We have been working with local authorities and with the Mexican National Center for Disaster Prevention (CENAPRED) to model the different risk associated to the volcano (lava, mudflows, and lahars). For the 3D representation we generated digital terrain models shown in Figure 3.

This information is stored on a relational database modeled after the OpenGis specification for SQL [9], extended to store the third dimension. For this process we have implemented classes in Java to export digital cartography in Shapefile format and GML documents to a database server. Servlet connections using JDBC provide the information retrieval. For the generation and translation of XML, we use JDOM [10]. We have been working with several XSLT stylesheets to generate reports and tables in HTML, 2D maps using SVG and 3D maps using X3D (translated then to VRML to visualize it).

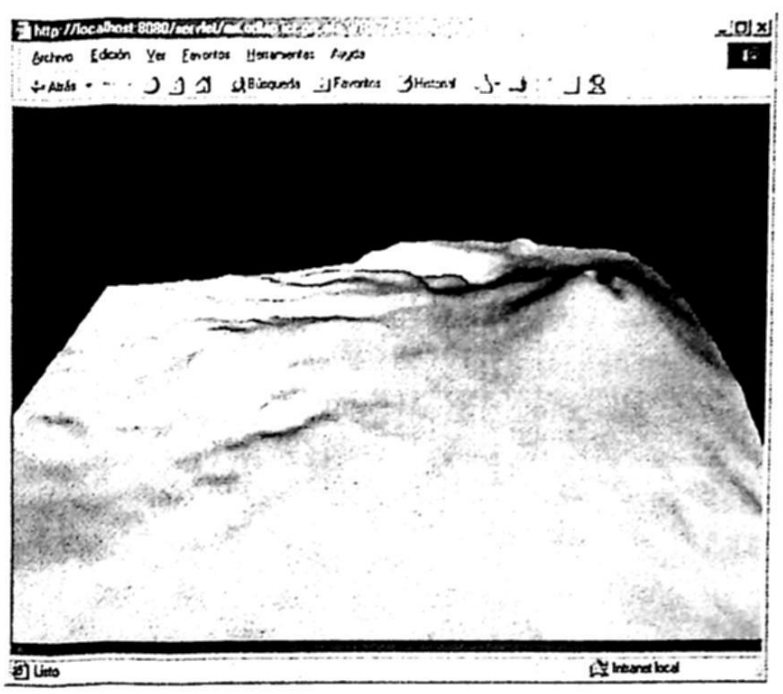

Figure 3. Popocatépetl digital model.

4.1 VRML AND GEOVRML

X3D is the XML equivalent of VRML, the translation of GML to X3D using an XSTL stylesheet is done in the following way, first we identify the geometric properties of every feature on the GML document. If the geometric property is a point, we generate a sphere, if it is a line or polygon we generate a sequence of lines in 3d, if it is terrain we generate a grid. When using VRML we need to transform the geographic coordinates into world coordinates but if we use the GeoVRML extension we just need to specify the spatial reference system and we can use the same coordinates [11]. After applying the stylesheet we have an X3D document, this specification is recent, so we need to translate this document into VRML to visualize it using a browser plug-in. In this case we use the stylesheet provided on [4].

5. CONCLUSION

We are using standards to share and integrate data from different sources. With a web-based interface users can access the data from different geographic locations and in different formats according to their needs. The use of VRML and its extension GeoVRML is an ideal representation of geographic information. We are looking to extend our services providing Metadata and dynamic map generation.

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