

GEOVRML OF BAKAR BAY - VISUALIZATION OF ECOLOGICAL HAZARD

Ivana Šainović Dipl.Ing.¹, Prof. Dr. Damir Medak²

¹ State Geodetic Administration, Gruska 20, HR-10 000 Zagreb, Croatia, ivana.sainovic@ka.hinet.hr

² University of Zagreb, Faculty of Geodesy, Department of Geomatics, Kačićeva 26, HR-10000 Zagreb, Croatia, damir.medak@geof.hr

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ABSTRACT:

In this paper the principle of new standard for 3D geographical data - GeoVRML, is explained, as well as its purposefulness and future of development in geo-applications. The data from Croatian Topographic Map, scale 1:25000, area of Bakar are used for the analysis. The ecological problems of air, soil and sea pollution, the protection of living and working places and human and natural environment are especially difficult and gave more cause for concern in Bakar Bay area. The map was loaded as the geodetic base into AutoCAD Overlay where it was semi automatically vectorized and digitized. After that the base was geocoded in software AutoCAD Map. The resulting dataset was saved in DXF form and sorted with a program written in QBASIC. The software Surfer was used for 3D visualization. The conversion with software 3DEM resulted with VRML and GeoVRML files for Internet applications. The Internet-browser is used to visualize VRML and GeoVRML reality of 3D shape. The transfer of data and data processing is explained for conjunction with GIS system on the example of ArcView 3D environment.

Possible application of this standard are in education, research and applied visualization for different purposes like showing different impacts on pollution in Bakar bay. The possibilities and limitations of 3D vectorizing module are discussed. This standard can be applied in science of measurement which is the major activity of geodesy, only through this standard it gets a new dimension of virtual reality.

At its core, Geo-VRML is simply a 3D interchange format. It defines most of the commonly used semantics found in today's 3D applications such as hierarchical transformations, light sources, viewpoints, geometry, animation, fog, material properties, and texture mapping. VRML also serves as a simple, multi-platform language for publishing 3D Web pages. Main advantage of georeferenced virtual reality is that virtual object or group of them can shown at user mind that he is walking through space where he can find orientation. Next generation of 3D visualization is implementation of Java in to X3D and VRML97.

The goal of this paper is to introduce the potential of advanced and innovative geoinformation technology in proper planning of revitalization of Bakar Bay. Three-dimensional virtual reality models of pollution effects on the environment, implemented in a standard GeoVRML, would be an excellent starting point for an integrated geoinformation system for monitoring and management of a precious natural resource

1. INTRODUCTION

1.1 Ecology and GIS

Living in clean environment is a right of every person given by Croatian Constitution.

Ecology is a science which is taking care about balance in environment between animal plants and places in which they live. The biggest task in keeping environment in balance is prevention from ecological hazard and keeping general public informed. Most important thing of keeping nature in balance is raising the awareness about ecology of each citizen.

GIS – geoinformation system is a powerful information technology dealing with collecting, processing, analysis and visualization of georeferenced data. GIS is closely related to digital cartography, but it has wider scope than that: it is a combination of hardware, software and people dealing with efficient usage of georeferenced data for decision making support. GIS is excellent tool for ecologic applications, as it

gives various possibilities of visualization of monitored environmental health.

So far the use of GIS in ecology was known at many levels, considering a lot of information represented. In what follows, accent is given on the usage of GeoVRML standard as a tool for monitoring the ecosystem, practical use of GIS and computer modeling with information system for the purpose of environment protection

Croatia still doesn't have updated registers about flora and fauna, either still doesn't have Atlas of it's expand. There is not enough information for quality monitoring of environment together with all consequences which goes from that fact.

With high quality collected information and good visualization of it we are taking under control and place under surveillance possible consequences of future actions.

Ecology management teams provide computer databases with the data used to produce spatial information related to natural

disasters. Today user has big expectations of modeling systems and in many instances relies on the output being of a high quality both in presentation and content.

Natural disasters are often talked about in relation to the risk to an individual, group of people or a valued resource. Spatial modeling and cartographic visualization can be used to assess the risk associated with a natural disaster. The analyst must also realize that the products can only represent simplified versions of what may possibly be very complex natural systems.

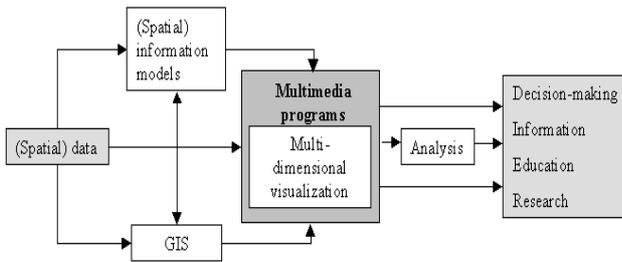


Figure1. Graphic representation of use of spatial data

1.2 Motivation

The ecologic problem in Bakar Bay is connected with recovery of polluted part of land and sea at the place next to the Coke plant in Bakar Bay. That factory was working for 16 years from 1978 to 1994. During that time cca. 11×10^6 tons of coke has been produced.. A single ton of coke leaves 40 kg of coke tar, so altogether through the mentioned period 440 000 t of coke tar was produced. Polluted environment is mostly caused because of unfinished complex for cleaning the coke. The coke factory is now closed and demolished in 2001. Dangerous gases and coke supplements together with dangerous gases are still in ground and urgent recovery is needed.

The data related to this study we got from other sources are talking about surface, thickness and composition of the polluted ground, without any map or plan that represents those data. Based on that information, a team of experts had chosen the way of recovering, which was appropriate to the ecological activists. The activists claim that the way of recovery could cause even more damage to the area.

Further actions for recovery of that polluted area are now active, and other ways of recovery is considering, for that purpose this visualization could help.

Polluted sea ground is also shown on this map, but for recovery of sea bottom there is no option yet and there is no any successful example in the world today as well.

1.3 Objective

Considering the fact that there is no any map used in this study and for better, direct and detailed approaches to the problem, this visualization could help. In this paper, visualization of amount of coke in ground and sea ground is shown through GeoVRML standard.

Aim of the visualization is to develop infrastructure for analyzing of data (data base, GIS, WWW servers). Result of which is data base and WWW service for monitoring of pollution, analyzing and controlling of the recovery process

Results are of primary importance for different scientific groups : ecology, population biology, biogeography, forestry pharmacy, agriculture and regional planning.

2. VRML AND GEOVRML

2.1 Description of standards

Geographic visualization emerged from geoinformation processing and displaying technology, such as cartography, GIS, Virtual Reality and visualization in scientific computing environment. It appearance lead to a lot of fundamental changes in many fields, for example data exploring, making social decision and understanding how things work. There are several reasons for its use:

- visualization helps users comprehend large quantities of data,
- visual attributes can present abstract representations of data,
- relationships among displayed entities become apparent,
- graphical techniques allow more direct intuitive interactions with the entities of interest.

VRML is one of internet applications whose focus is on the 3D graphics. GeoVRML is used for visualization of georeferenced data using VRML 97 standard. Some of alternative approaches can do some of the things better than VRML but they have disadvantages too (Java3D, 3DML, PGML...)

VRML is an ISO standard and it is the most popular format, according to many of the authors publishing research papers in area of web 3D graphic. GeoVRML is a standard which is added to VRML97 ISO specification.

Advantages of Virtual reality are 3D-interactivity, immersion, imagination. VRML might visualize intelligent geoinformation in WWW 3D environment, especially if model components are linked to spatial databases.

GeoVRML 1.0 is a new standard Web-based 3D technology. It is an extension of VRML which allows exact presentation of spatially defined data, giving to the Internet user possibility of integrating forms defined in 3D into the Virtual Reality.

GeoVRML is 3D representation of georeferenced data on the web i.e. integration of GIS with VRML to allow users to create models and simulations that are grounded in physical real-world data.

In a general 3D-simulation system, the user is only an external observer, and he or she can see only the graphic that computer generates through the screen. But VR allows the user to become an inside participant of environment through all kinds of function combination. We can easily say it is a new way of seeing and exploring the world. Only the VRML can be practically used for walk-through simulation.

VRML is a high-performance language for 3-D visualization on the WWW. As a programming language and library for 3-D computer graphics, VRML has many functions such as shading, setting objects, projection, and texture mapping. Virtual reality worlds can be easily built on the WWW with this technology. VRML 1.0 was introduced in 1994 and VRML 2.0 (97) with more dynamic and interactive functions was made in 1996. GeoVRML and X3D, are the successors of VRML. In this

study, Geo VRML was used in the present system.

To write and run GeoVRML code you should download VRML97 browser support for Java in script node and Internet browser is required together with GeoVRML runtime environment. Cosmo Player and other VRML browsers can be downloaded as freeware, and the development environment can be built economically (Honjo and Lim, 2001). GeoVRML is a set of nodes inserted into VRML PROTOs. A PROTO is direct way of putting extensions into VRML.

VRML is able to show static and animated dynamic three-dimensional and multimedia objects with hyperlinks to other media such as text, voice, movie and pictures. This standard supports extensive model which allows us to define the new dynamic three-dimensional object. Existence of mapping between VRML object and usually used three-dimensional API (Application Programming Interface) attribute.

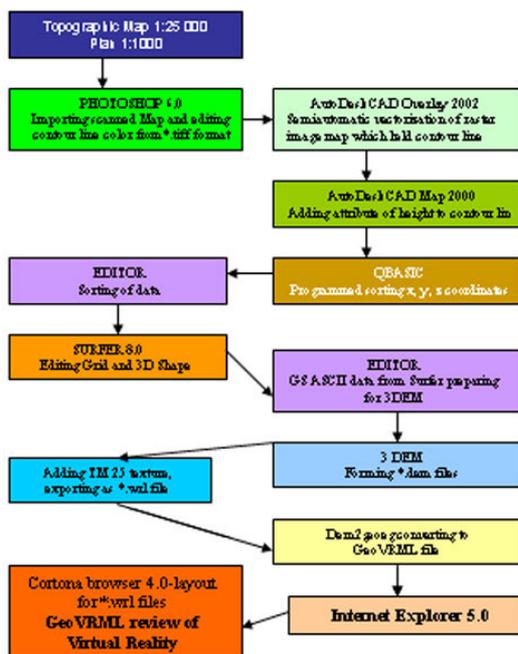


Figure 2. From map to GeoVRML

3. BAKAR BAY

3.1 History of Bakar bay

The bay of Bakar is the largest bay of the Croatian Littoral. It has extraordinary natural and maritime characteristics which make it the most favorable and protected part of the larger Kvarner bay. Surrounded by steep sheer rocks, this 4.6 km long and 600 meters wide bay has always been a certain oasis for all the activities corresponding with the sea. In the north-western part of the bay there is the city of Bakar, renown for its rich and turbulent history.

Bakar used to be a very important fisherman, trade, wine-growing and marine centre. Nowadays, as events turned round, Bakar is a part of Rijeka's port and industrial basin. The problems of air, soil and sea pollution, excessive noise, the protection of living and working places and human and natural

environment are especially difficult and gave more cause for concern. The air in Bakar and its surrounding area is polluted with phenyl concentration of which exceeds all legal norms. The maximum permissible level of sulfur dioxide in the air in the centre of Rijeka has already been exceeded. Some sources of drinking water, particularly the coastline around Bakar Bay are in potential danger from pollution.

Bakar might be again a revitalized maritime centre. Building of marinas, shore – quay and shipyard of a smaller size, all along the Bakar bay coast are possible.



Aerial photo 3. Coke factory 1978.
(©State Geodetic Administration Copyright 1978)



Photo 4. Place where Coke factory was
(© Dokmanović Ranko Copyright 2003)

3.2 Bakar bay today

Considering the fact that Coke factory has been working for 16 years, there is a serious thought that area is polluted with dangerous substances.

Researching on this area had given a data about amount of pollution and consistency of dangerous substances.

It is still believed that underground waters are not polluted yet, but it is also just matter of time, when it will happen.

Polluted area of sea ground sizes up to 15 000m². At the plateau of ex Coke plant was found contamination up to 10 meters deep. During 3 phases of researching at the plateau of Coke plant has been made 18 deep holes for purposes of monitoring the area through 3 years of researching.

The results are shown in visualisation of polluted area.

4. MODEL OF ENVIRONMENT POLLUTION

4.1 Texture projection

In order to improve the third dimension of 3D terrain, we need to overlap corresponding terrain map with an appropriate Terrain model. The surface of the model is a curved surface made up of large amount of polygons area, while the texture is plane, we must employ definite arithmetic to match them, and make texture projection. It is a mapping relationship in a kind of a fine transformation.

$$X = a_0 + a_1X_T + a_2Y_T + a_3X_TY_T$$

$$Y = b_0 + b_1X_T + b_2Y_T + b_3X_TY_T$$

X_T, Y_T = corresponding terrain model point coordinates
 X, Y = coordinates of a point in texture

A_i, b_i eight transformation parameters which can be calculated to the four angle point of the texture, and used to confirm project relationship between the texture and terrain

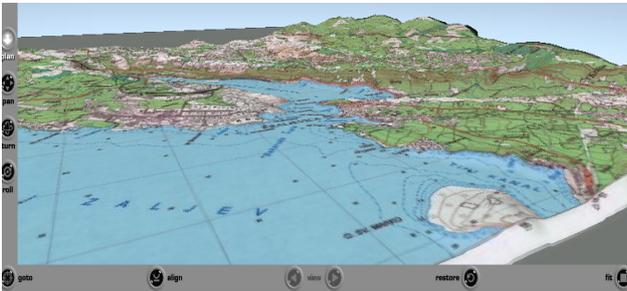


Figure 5. GeoVRML of Bakar Bay

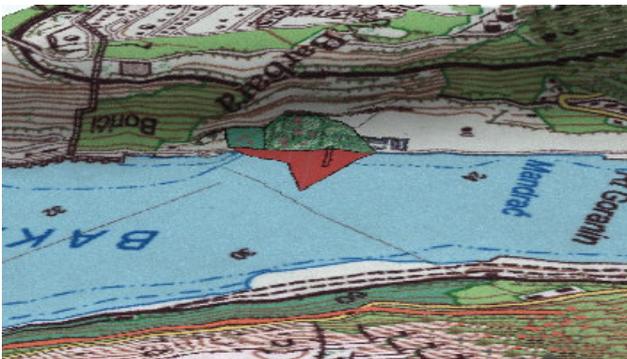


Figure 6. GeoVRML of polluted area

4.2 CONCLUSION

In this paper, we show that GeoVRML-technology can provide another perspective of an important ecological problem. This way of visualization should be implemented in any ecological research to provide help for a better decision making.

Often the best way to understand and learn about complicated scientific ideas is to see them represented in 3D. Scientists are also eager to explain the excitement of their areas of expertise in ways that didn't involve long, boring paragraphs in dusty textbooks and unsatisfying pictures, diagrams and tables that are hard to understand. GeoVRML provides a general way to specify many of the features that scientists need to visualize, including seafloor terrain at the highest resolution.

By a successful decision of proper recovery technique, the Bakar Bay might be transformed from an enormous ecological hazard to a revitalized maritime centre. Application of modern standards in 3D visualization applicable to the Internet can help in raising the public awareness of ecological problems and importance of the recovery process.



Figure 7. Position of Bakar Bay
 (© State Geodetic Administration Copyright 2004)



Figure 8. Panoramic picture of Bakar Bay
(© Dokmanović Ranko Copyright 2003)

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