VISUALISATION OF HEALTH DATA THROUGH SVG MAPS

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ABSTRACT:

Public health is the one oh the human activities producing very important but very complicated and often unintelligible spatial data. Health data and its correct interpretation can have preventative effect or can map and control different epidemics.

The two-year project VisualHealth (The Visualization of Health Data for the Support of Interdisciplinary Education and Relation with Public; the project code 2E08028) tried to explore abilities of digital cartography to present health data from the Czech republic to experts and public. In this project there are cooperating three partners from the Czech Republic – the University of West Bohemia in Pilsen, Masaryk University in Brno (the leader of the project) and Faculty Hospital Brno. As the one of applicable technology (except static maps, Java application and Google Earth) the SVG (Scalable Vector Graphics) was used. The thematic maps (choropleth maps and diagramm maps) were generated from GML (Geography Markup Language) source data through XSLT (Extensible Stylesheet Language Transformation) styles.

The paper can be divided into two parts. First part describe the project VisualHealth and its output above all SVG maps. The second part is focused on future steps and further development. It shows a draft of improvements of current application like an addition of multimedia, a design of GUI (Graphical User Interface) or transformation of current desktop solution to web and service oriented application. We also plan a modification of cartographic part of application. All changes aspire to a creation of the complete web solution being able to generate thematic maps from uploaded spatial data.

1. INTRODUCTION

Current economical crisis places the emphasize on cost savings of majority of states of the world. The cost of health care are one of the main financial problems of state administrations in the whole world. This problem rises up in the context of increase of civilisation diseases like diabetes or carcinoma. Politicians, economists and health expert suggest many solution and precautions. But all agree on the importance of the prevention and the availability of information.

This paper tries to show how the cartography and its products can influence health condition and health state through providing spatial located data, information and knowledges describing a spread of diseases, number of patients, cost of therapy etc. This information and knowledges could be acquired by interpretation of cartographic visualisation of spatial health data. Although public health is the one of the human activities producing very important data, these data sets are often very complicated and often unintelligible. According to (Cerba, 2009b) the visualisation through methods of thematic cartography brings many indispensable benefits in comparison with other types of data presentations (text documents, tables, charts...):

- Thematic maps are more intelligible and clear than very complicated data, tables or charts.
- The different types of thematic maps (e.g. choropleth maps, cartograms, maps with isolines etc.) are very popular with general public and also with experts.
- Through maps users are able to connect information and location (concrete place). Such concretization or approach of abstract and unmeaning numbers can evoke an higher level of consciousness of weight of information.
- Simple interconnection to new attractive technologies and tools, such as digital globes or multimedia solutions.

The paper can be divided into two parts. First part describe the project VisualHealth and its cartographic outputs above all SVG (Scalable Vector Graphics) thematic maps and principles of their construction. The second part is focused on future steps and further development of system of generation of thematic maps based on XML (Extensible Markup Language). It shows a list of improvements of current application like an addition of multimedia or a design of GUI (Graphical User Interface).

2. PROJECT VISUALHEALTH

The two-year project VisualHealth (The Visualization of Health Data for the Support of Interdisciplinary Education and Relation with Public; the project code 2E08028) tried to explore abilities of digital cartography to present health data from the Czech republic to experts and public. This project was developed within the framework of Programme 2E – Human sources (2006-2011) of Ministry of Education, Youth and Sports in the Czech Republic. In this project there are cooperating three partners from the Czech Republic

1. The University of West Bohemia in Pilsen (Faculty of Applied Sciences, Department of Mathematics, Section of Geomatics),
2. Masaryk University in Brno (the leader of the project),
3. Faculty Hospital Brno.

The project VisualHealth was focused mostly on cartographic visualization, on creating of different types of thematic maps of public health data for education, their presentation and popularization. Simple insight through easy comprehensible maps to this very complicated data could lead to a higher level of prevention and protection of health.

The results of VisualHealth project are published on the web portal (http://zdravi.geogr.muni.cz), only a part of this portal is in English, because the maps and other outputs are mainly destined for Czech users. The portal is divided into two parts – for patients and for experts (Figure 1). Both parts contain different types of thematic maps and other components like vocabulary or list of sources.

Figure 1: VisualHealth Portal

Within the framework of this project there are processed different cartographic methods of spatial data visualization on the Internet. There are four types of maps:

1. Static maps in PDF (Portable Document Format) format.
2. Dynamic maps based on XML source data, XSLT (Extensible Stylesheet Language – Transformation) templates and SVG graphics. This type of maps is described in this paper (example on Figure 3).
3. Interactive maps – Java tool designed for cartographic publication of time series of health data.
4. "Google" maps – thematic maps for Google Earth or Google Earth plugins generated from database in real-time.

3. PRINCIPLE OF CONSTRUCTION OF USED SVG THEMATIC MAPS

Thematic maps presented in SVG format are one of types of presentation of health data in VisualHealth projects. Why was the SVG formats chosen? The main reason there is XML compatibility. XML represents the universal tool to creation of exchange formats. There are many different benefits of using XML in digital cartography (based on Harold, 2001; Marchal, 2000; Ray, 2003; Cerba, 2009b):

- The data is self-describing.
- The data can be manipulated with standard tools.
- The data can be viewed with standard tools.
- The application of standards supports interoperability.
- Different views of the same data are easy to create with

style sheets.
- The capability to convert XML documents to different media: the Web, print, and more.
- The emphasis on structure means that XML documents are better equipped to withstand the test of time (structure is more stable than formatting).
- Maximum error checking.

Main vector formats on the web (except Adobe Flash) are based on XML. SVG is widely supported by important web page browsers including software products for mobile solutions.

Also the main official standardized spatial format, Geography Markup Language (GML) is based on the XML too. The source spatial data and target data (thematic maps) are based on the common platform. It would be very useful to manage the transformation (or creation of maps) between source and target data by some XML based tool too. Therefore we applied XSLT and other similar languages (so-called XML Tranducers) – CSS (Cascading Style Sheets), XLink (XML Linking Language) or XPath (XML Path Language) – see Figure 2.
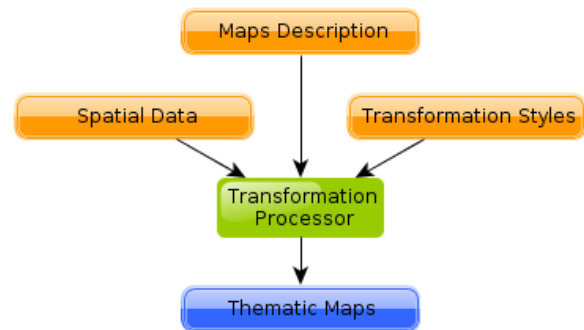

Figure 2. Basic scheme of generating of thematic maps

On the Figure 2 there are shown four basic elements used to generate thematic maps in the project VisualHealth.

1. Maps description – particular thematic maps are described in so-called control file. This file based on XML specifies the fundamental attributes of maps like source data, cartographic interpretation methods, used colours, etc. The control file is connected with schema file (written in the compact syntax of RELAX NG[*] format), which defines elements, attributes, their limits and restrictions. The control and schema files and advantages of formalized description of maps are detailed described in (Cerba, 2009b).
2. Source spatial data – original data are kept in database (PostgreSQL). The open-source qGIS (Quantum GIS) tool extracted data to file system structure (GML format) and this data was processed by transformation processor.
3. Transformation styles coded in XSLT 2.0. In this example three interconnected style files was created (see detail description in Cerba, 2009b).
4. Transformation processor – we decided to use the open-

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[*] Regular Language for XML Next Generation.

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source version of Saxon 9.1.0.1J. We also tested processors integrated into web browsers (Cerba, 2009a).

The project VisualHealth had the one main target – to create simple and intelligible thematic maps with small size and wide possibilities of view. We created 33 groups of thematic maps. These groups visualise oncology and diabetes data (e.g. therapy costs) in years 1996-2007. They contain 329 maps with maximal size 296,3 kB. The maps including simple SVG graphical user interface – menu, list of maps, links to maps and simple metainformation are integrated into web page http://zdravi.geogr.muni.cz (Figure 3).
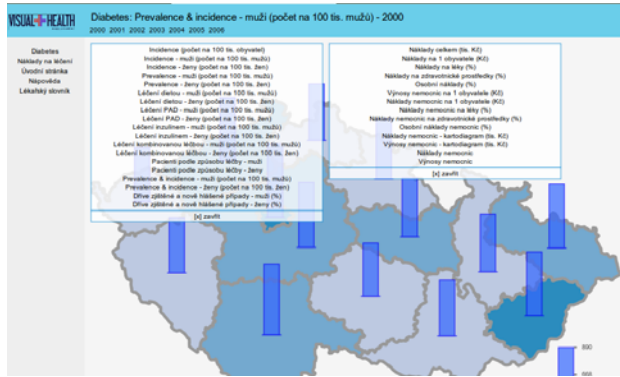

Figure 3: Example of VisualHealth SVG thematic map

The similar approach to thematic maps was used in project of the printed publication Atlas of International Relationships (Waisova et al., 2007) presented in XXIII. ICA Conference in Moscow (Cerba, 2007) and in Second International Conference on Cartography and GIS, Borovets, Bulgaria (Cerba, 2008).

4. FUTURE STEPS

The VisualHealth project was finished at the end of last year, but the development of solution introduced in this paper will continue. The following list summarizes the planned steps of further development:

- The building and designing of user interface making for the editation and modification of control file describing the maps.
- Improving of graphical user interface of target maps (zooming, interactive viewing of data values, help).
- A creation a detailed list of schemes and other resources (e.g. ontologies), which relate to cartography domain or sub-issues of cartography. These schemes, or parts (e.g. Symbology Encoding Implementation Specification in Muller, 2006, DiaML - Diagram Markup Language in Schnabel, 2006 or CartoOWL in Karam et al., 2010) should be mutually connected and re-used.
- The optimization and unification of actual XSLT templates.
- The XSLT coding of new cartographic interpretation methods.
- Addition of multimedia items (hypertext, animations, video and audio files) to existing maps (details in Cerba, 2010).

- In order to be formalise the description of maps currently used, it is required to establish a robust system of cartographic terminology. Within the existence of different cartographic historical schools and concepts it is not possible to unify all terms and concepts identifying the elements of maps and map-generating processes. Therefore, such system must be based on a thesaurus and domain ontologies.
- The finalization and optimization of data model written in RELAX NG. Improving and modularization of data model (context variables, standard data types). Transformation of data model into other schema languages.
- To enable to use databases as a spatial data source.
- The conversion of desktop application to the server application making possible online map generating.
- Providing of suggested server application as the OGC (Open Geospatial Consortium) standard WPS (Web Processing Service). This solution make possible to interconnect cartographic visualisation with other service applications.

All changes aspire to a creation of the complete web solution being able to generate thematic maps from uploaded spatial data.

5. CONCLUSION

All XML technologies, including SVG, are strongly connected with the future of information sciences including geoinformatics, geomatics and digital cartography, too. XML technologies represent the fundamental component of next evolutionary phases of web. Platforms such as Web 2.0, Web 3.0 or Semantic Web are based on XML and technologies based on XML. SVG thematic maps, principles and methods of their generating and above all the formalized description of the maps and their components are very important in the term of principles of semantic web, which represents one of the fundamental activities of W3C – W3C Semantic Web Activity. It is necessary to mention the role of open and standardised technologies (such as SVG) in an implementation of web technologies like web services and in developing SDI (Spatial Data Infrastructure).

It is possible to search connections of XML and cartography in the activities of International Cartographic Association (ICA). In ICA Research Agenda (Virrantaus & Fairbairn, 2007) there are emphasized terms like interoperability, accessibility, web technologies, cooperation with other branches of science, data harmonization, semantics, metadata, visualization models, etc. The technologies, methods and principles mentioned in this paper are relating to this documents. Described application support mainly these aspect of ICA Research Agenda focused on web technologies and standards – e.g. geoinformation (semantics, ontologies) or usability and accessibility of the maps (user centred design). In some cases (e.g. web technologies, metadata or semantics) XML and related technologies represent the fundamental component.

Thematic maps created in the VisualHealth project represent the result of cooperation of experts on cartography, SVG (information technologies), medicine and public relation. Only such cross-science interconnection makes possible the building and distribution of high-quality maps and other cartographic products,

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which offer a correct, useful and intelligible interpretation of complicated statistical data with spatial linkage.

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