OPEN REGIONAL INTERNET ATLAS OF SOUTH MORAVIA

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Abstract: *An issue of our article is a design of an open electronic atlas of the South Moravia region. The Atlas is open for inserting new cartographic methods and themes. In frame of the design of the atlas we can distinguish three main parts. First one is a publishing environment composed from atlas engine, client interface, inserting interface and procedures. Second one is a reference base which is selection of important topographic features with core in landscape skeleton. Last one is cartographic infrastructure, a key part of the Atlas. The infrastructure is composed from generalization and visualization schemas and methods, visualization styles, verification mechanisms and transformation procedures.*

INTRODUCTION

Development of electronic atlases is topical issue of contemporary cartography. Likewise in the development of electronic maps, at the beginning many of electronic atlases are just copy of a printed atlas (often not even very good one due simplification of symbolism). Facilities of electronic environment like interactivity, dynamics and variability is dramatically changing nature of maps. A design of atlases in electronic environment should identically incorporate these facilities. Our open regional atlas is one of the attempts to define (or redefine) such electronic atlas.

A project of Open Regional Internet Atlas of South Moravia is one of principal tasks which have been solved in our laboratory. The basic goal of the project is to build cartographic publishing environment for presentation of results of geographical research in South Moravia region. The Atlas is composed as a cartographic communication medium between processor of geographic information and its user. A key adjective in the name of the project is “open”.

Openness of the Atlas lies in the possibility to insert new themes without breaking content or graphic consistency of the whole Atlas. The insertion of new theme is proceed through form filling, which allows to classify new theme according to atlas sections, isomorphism of the content and method of cartographic visualization. One of the benefits of the atlas concept is also possibility to expand accessible methods of cartographic visualization. From user point of view is the Atlas complex of full featured adaptable electronic maps which allow an exploratory analysis of served geographic information.

At the beginning were established basic requests on the Atlas functionality. To important ones belongs:

- preservation of cartographic correctness on display
- smooth motion through scale range 1:25.000 – 1: 1.000.000
- ability to change visualization method if a theme is suitable to this
- possibility to specify a level of theme detail
- possibility to choose a level of reference according to theme context
- at all circumstances preservation of defined parameters of a map face content density
- possibility to insert new visualization methods
- possibility to insert new visualization styles
- preservation of topological consistency of the Atlas
- accessibility of the Atlas through the INTERNET

In contrast to concept of printed atlases, where the key role plays selection of fixed amount of corresponding themes and their visual harmonisation, in the open electronic atlas is the core to create a cartographic infrastructure. The cartographic infrastructure is complex of tools and rules which allow homogeneous and correct representation of geographical information inside the Atlas. The cartographic infrastructure is composed from three main parts:

- publication environment
- reference base
- visualisation and generalisation schemas

PUBLICATION ENVIRONMENT

The publication environment basically represents technological background of the Atlas. The environment is composed from an atlas engine and client applications for users and for processors. Within implementation process of the environment we have used open standards and open source software components. One part of the environment is non-technological – insertion procedures.

The atlas engine

A basic part of the atlas engine is a database engine. We have tested and are still testing various alternatives from open source software for implementation of the atlas database management. The atlas database is composed from various features – geodata, symbols, rules, code components. Nowadays we use solution based on two database engines – MySQL for storage of geodata, and eXist for rest of features. Both engines are, of course, open source software. MySQL is a relational database engine with support for geodata types based on OGC simple feature recommendation (this support is nowadays limited on possibility to store geometry and use spatial predicates in queries). eXist is a simple native XML database engine. This engine is suitable to our purposes because of usage of XML notation for majority of atlas features. In the framework of the Atlas is W3 consortium standard SVG the most important XML namespace. The eXist is related to http server engine Jetty. This simple web server we use for communication between client and server part of the atlas engine.

The core of the atlas engine is a map compiler. The map compiler retrieve geodata from database and base on rules compile map face, dynamic map features and attach appropriate cartometric and exploratory analysis functions. The map compiler is created in JAVA environment. To the main libraries used inside of the map compiler belongs:

- JTS – Java Topology Suite, basic geoprocessor handling OGC simple feature geometry and planar graphs.
- Batik – a SVG processing library

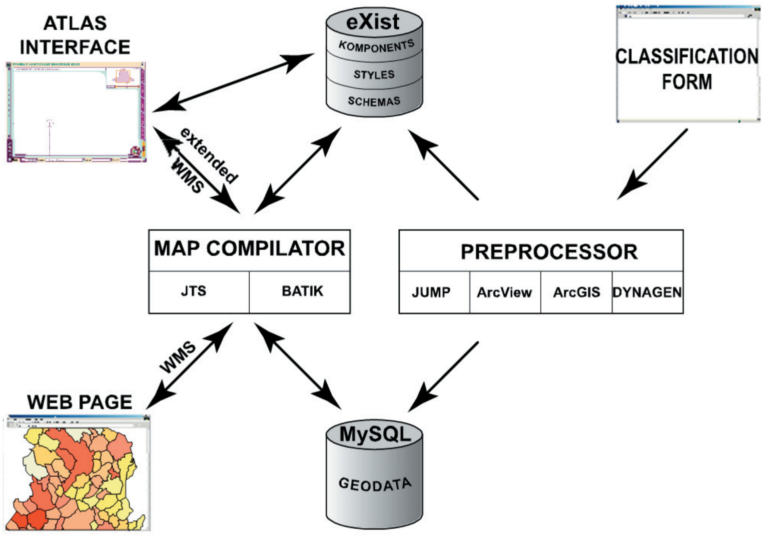

Figure 1: The Atlas Engine structure

SVG is the most used standard inside of the Atlas. Symbols are stored in SVG format, maps are compiled in SVG and even client applications are based on SVG. SVG is well adopted by cartographic community and according our opinion it is basic graphic standard for electronic cartography. SVG has many advantages which support usability of this format like extensibility, dynamics and possibility of distributed processing etc.

A user client application

As was mentioned above this application is created completely in SVG. Static components (graphic elements and routines) are stored in the atlas engine database and dynamic ones are partially generated by the atlas engine and partially through routines. Routines are realised by code written in ECMA Script (JavaScript) and manipulating with client application through DOM interface.

For function of the client application is necessary to have proper SVG rendering engine on user side. In majority of the project time we used Adobe SVG Viewer, but nowadays we are in transition to the Batik Squiggle environment. Main reason for this movement is easier implementation of cartometric functions. We still continue in support of SVG Viewer, but lack of development on Adobe side gives a limited possibility. This is one of relative weak point of SVG, SVG is standard which is implemented by many providers, every provider implement just subset of this standard. A basic drawing is supported in every renderer but advanced functions are often missing. Batik is nowadays closest to full implementation of SVG standard.

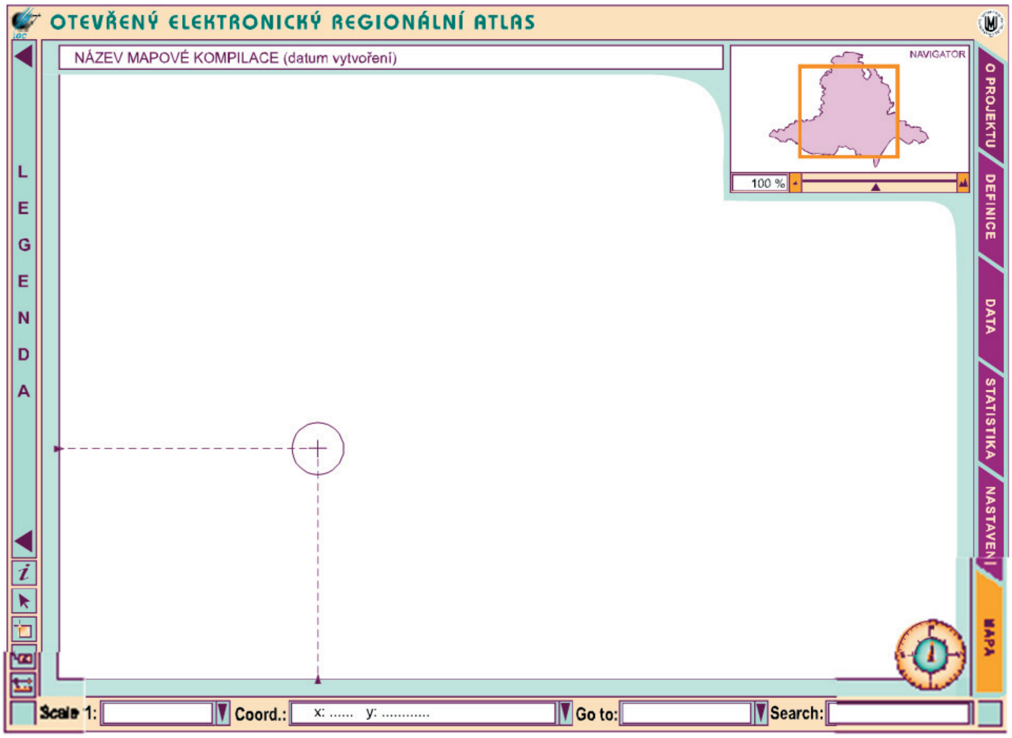

Figure 2: Design of the Atlas user interface

Communication between client and server is based on extension of OGC WMS standard. This allows two modes of the atlas engine. One mode is serving dynamic map components for native client and another one is generating of static SVG or PNG maps for random WMS client software.

An insertion of themes

There are defined an edit interface and set of pre-processing tools for support of insertion of new themes. The editing interface is composed from interactive forms that help to classify theme, to identify theme source, to identify demands on new symbols and to define generalisation demands. Insertion of themes is semi-automated off-line process. Data provider must create an atlas engine database node where are data stored in transformed form. Pre-processing tools are related to harmonisation of data with reference base, extending data model by generalisation parameters and defining of corresponding generalisation and visualisation schemes. Majority of pre-processing is still running in commercial GIS environments but continue transition under JUMP environment (JUMP is desktop GIS software based on JTS library).

REFERENCE BASE

The Atlas reference layer is based on DMU25 (Digital Model of Landscape, scale 1:25.000). Terrain lines (valley lines, delineation of watersheds and terrain edges) were derived from contours and elevation points of this model. To terrain lines was added hydrography and network of stable communications. Formed system was organized – terrain lines by geomorfometric characteristics, hydrography by Horton schema in combination with other hydrological parameters, communications by categories. Such defined lines create coverage of cells – landscape skeleton. During scale changes are cells amalgamated. Every feature inside of the atlas database belongs to some cell. All generalisation procedures and checking are running inside of scale appropriate cells. If some features cross cell borders they are segmented and follow cell amalgamation. This procedure supports to keep topological consistency.

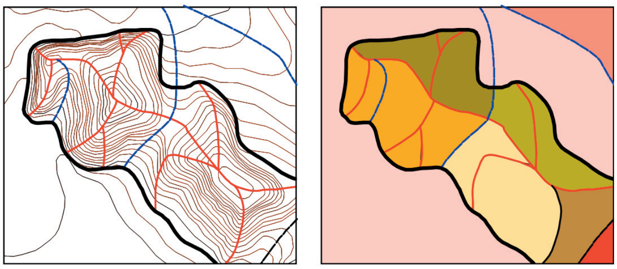

Figure 3: Example of landscape skeleton

Other components of reference base are features which help easy transformation from a source database into the atlas database. These features are selected from stable objects in all potential topographic backgrounds used for geographic mapping in our region. For these backgrounds is also landscape skeleton derived and identified with the atlas landscape skeleton. For new mapping is provided the reference base from the Atlas, transformation process is no necessary in this case.

Geodatabase DMU25 was maintained in coordinate system S-42. For the Atlas purpose was topographic base transformed into ETRS-TM33 (European Terrestrial Reference System – Transverse Mercator, zone number 33), which is European standard. Another reason for this conversion is compatibility with GPS measurements. Conversion into ETRS-LCC is implemented for support of demographic information.

SCHEMAS

Schemas describe behaviour of cartographic features according to scale, purpose, context and interaction with the rest of entities in a map face. Schemas are based on set of rules, cartometric measurements, generalization algorithms, classification algorithms, symbol libraries and scale libraries. Schemas interact with pre-processed parameters, which are stored in geodatabase.

Generalisation schemas and procedures

Cartographic generalisation in the Atlas comes out from Bertin's model of conceptual and structural generalisation. Conceptual changes (aggregation, collapse, coalescence) occur in selected focal scales. Between focal scales are realised jus structural changes (simplification, omition, displacement and resymbolisation). Generalisation processes are automated, based on rules and supported by the data model (clusters definition and simplification) and the schemes (resymbolisation and displacement). Usage of real-time generalisation is limited, so only pre-processed combination of features are allowed. Generalisation rules and algorithms are under development, nowadays is implemented:

- Simplification – pre-processing based on Visvalingam-Whyatt and edgebuffer algorithms, stored as a descriptor of line

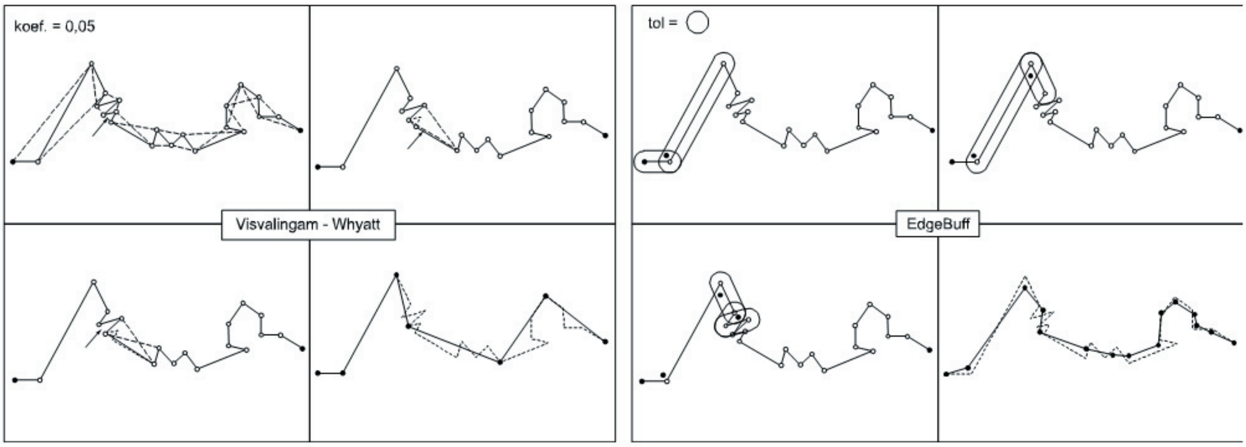

Figure 4: Principle of Visvaligam-Whyat algorithm and edgebuff algorithm

- Amalgamation and aggregation – pre-processed based on combination of buffer, convex hull and simplification methods. Differences from existing line segment are stored like new feature.
- Displacement – shift of feature on the axis defined by two centroids of interacting features. Related feature and size of shift is stored in the scheme.
- Dissolve – whole feature is amalgamated with semantically closest neighbour feature.
- Collapse
- Coalescence – coalescing segments are defined like independent features
- Selection – basically Topfer law driven

Generalisation tasks are simplified by minimal usage of annotation. Majority of annotations are realised "on mouse" events.

Visualisation schemes and styles

Visualisation schemes are description of alternative visualisation of atlas themes through the use of different means of cartographic expression. Nowadays are supported choropleth maps, chorochromatic maps, proportional and unproportional symbols and cartodiagrams. Visualisation schemes also describe themes interaction, level of graphical importance of the feature and conversions between symbol scales.

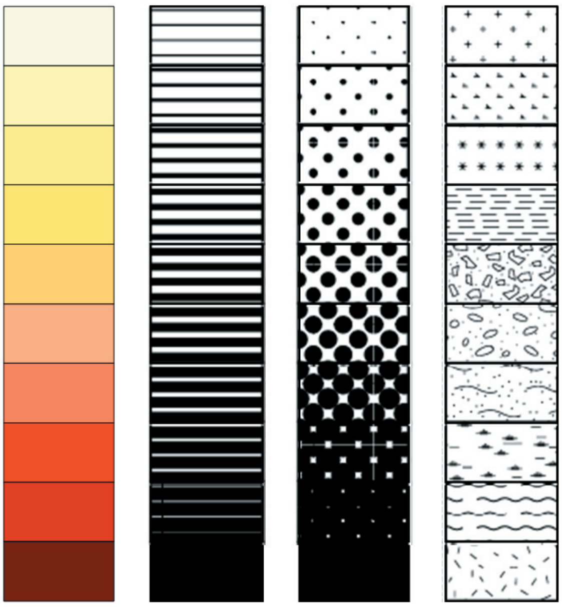

Figure 5: Example of visualization styles

By Visualisation style we understand systems beforehand defined colour tints (tints have to be organised in a fashion to create meaningful sequence according to meaning of visualized characteristic), lists of symbols, and systems of textures and/or templates of diagrams. Visualisation styles are stored away as graphic entities in SVG format in eXist database. Visualization styles are assigned to geodata according to interpretation of visualization schemes by the atlas engine.

CONTENT DEVELOPMENT

For testing and example purposes are in the Atlas inserted some initial themes. Beside topographic background are inserted pedogeographical and geomorphological geodata, urban plans and census units with demographic attributes. As a complicated issue arise willingness of data providers to keep data in the Atlas after the end of the experimental stage. In any case, the Atlas in final stage will serve geographic information created by students within bachelor and master thesis. Also regional government of South Moravia will support content of the Atlas.

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