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ADVANCED SEMI-AUTOMATIC VISUALIZATION OF SPATIAL DATA USING INSTANTATLAS

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Introduction

Semi-automatic vizualization is one of the most appropriate tools for proceeding of the representative geodatabases and digital spatial data. It enables effective management and in particular the prompt presentation of the data with minimal software requirements, knowledge and time of users. There is no need several different programs to produce maps, graphs, charts and tables - everything is pre-arranged in thematic templates, in which only the user uploads the data and adjust output according to their specific requirements.

The map is amongst the most effective way to present a spatial and attribute data. Through the visualization in maps, also the geospatial relationships of objects can be made visible (Kraak, Ormeling, 2003).

The output of semi-automatic visualization of spatial data can be analog map, interactive digital map or a map on the web. It is in relation to the various types of storage or procuring of geospatial data that one discerns between analogue maps and various types of virtual maps (Moellering, 1983). Among the programs offers functionality semiautomatic creation of spatial data visualization include a program InstantAtlas. In addition, includes the possibility of direct publishing on the web, making it more successful in competition because the Internet and World Wide Web (WWW) have been widely applied in delivering, processing, and publishing geospatial data (Zhou et al., 2006).

Automatic and Semi-automatic Visualization of Geodata

Automatic creation of visualization is the easiest way to get image output from digital spatial data. The user is totally dependent on the used software, he can not affect how it looks, colors, placement diagrams, or he can not select individual elements composing the resulting visualization. Such tools include products from Google.

If the semi-automatic vizualization is used, user has got the possibility of map or data preview making. There are a large number of tools for further adjustments to the resulting visualization. User can choose the mode, different templates; themes can add different elements, descriptions, etc. In the sophisticated programs for creating visualization, the user had the possibility to create direct data analysis. When concerning the program InstantAtlas it is eg automatic calculations, regression analysis, etc. According to the Konečný (2010) to automate the creation of graphic output is called adaptive cartography.

Because of accessibility of visualization tools, a map is becoming popular among general laic public. By reason of the increasing number of map creators, it is necessary to preserve the awareness of set rules and principles. Therefore the user orientation is one of the most important problems of current cartography. This situation has recently led to the emergence of map creation tools designed for a concrete user and a concrete situation. According to Staněk, Konečný, Friedmannová (2007) this approach is a new trend in cartography. It offers more or less the same functionality as GIS map creation tools, but it processes cartographic visualizations automatically. The users can influence adaptive maps only indirectly, according to a context.

Automatic and Semi-automatic Visualization Tools

Nowadays, there are several tools that enable automatic and semi-automatic visualizations. While some of them need to be paid for, some are offered free or at least partly free.

The products made by the company Google belong to the most popular and most frequently used tools by both professional and laic public. The reason for it is the fact that they are easily accessible as well as very user-friendly. The users can make use of Google Maps or a virtual globe called Google Earth. Moreover, by using Google Earth application it is possible to create own geodata. The API interface tools enable to create virtually any map or even whole web application for automatic or semi-automatic map creation. The advantage of semi-automatic creation of maps is offer of topographic bacground. The company Google offers three basic options of topographical base – aerial photographs, satellite images, and maps or terrain maps. To visualize a thematic point layer, it is possible to choose one of predefined symbols or to upload own symbols. Based on the API from Google and its possibilities many web sites are based as a "map

generator", a freely available application that offers semi-automatic map creation. Specifically, such applications are available on the website of MapBuilder (www.mapbuilder.net), Thematic Mapping (available at http://thematicmapping.org) or KML Factbook (available on www.kmlfactbook.org).

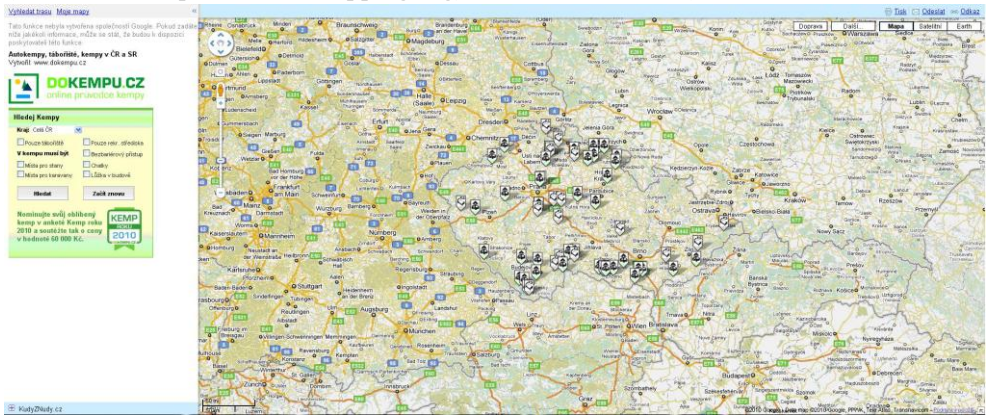

Fig. 1: Example of automatic visualization in Google Maps.

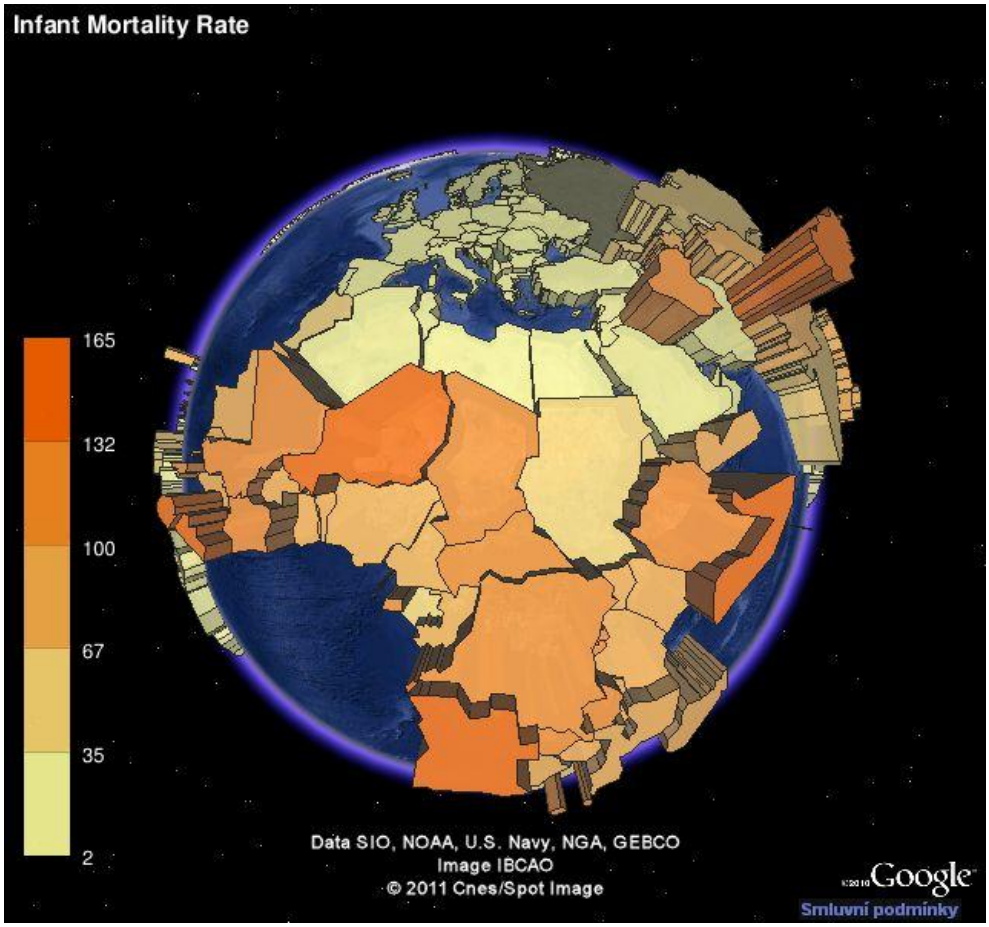

Fig. 2: Example of automatic visualization in Google Earth.

ArcGIS online is another tool which belongs to the group of automatic or semi-automatic tools. It extends the ArcGIS Server, an open and interoperable server which supports a wide range of applications. It offers tools for easy creation of map applications with the help of a dynamic map memory cache. It supports spatial editing tasks for applications like adding, modifying and deleting map components (points, lines, polygons). Apart from this it supports server based analyses and geo-processing which cover a vector, a raster, 3D and net analyses as well as models, scripts and tools (Pechanec, Vávra, 2010). The form of data download is rather complicated and it requires the free accessibility of data on the web. The users can also add data by using a connection to a chosen server. Another step is a definition of characteristics of thematic layers if data setting allows it (some of the data cannot be freely adjusted since they serve as a fixed raster only). Apart from thematic data, it is possible to choose out of twelve predefined topographic bases e.g. topographic maps or aerial photographs.

Another tool for semi-automatic creation of maps is for example SmartDraw from the same company. This tool offers automatic formatting of maps (such as choice of color scale, point symbols, etc.), specification of map composition or Quick-Start Templates, a set of basic data in the form of state contours. The resulting static maps can be published in the form of several graphic formats and also these maps can be directly printed.

Fig. 3: Example of automatic visualization in ArcGIS Online.

InstantAtlas

InstantAtlas program is primarily intended for the visualization of various statistical data. It is ideal for anyone who has got an extensive amount of tables and databases full of data, and who wishes to visualize them in the form of map and publish them on the web.

InstantAtlas works on the semi-automatic principle of an offline generation of map outputs. Dynamic outputs can be later easily placed on a web site. When publishing a report, the users have to take three obligatory steps. Firstly, they have to select a map composition or one of the offered templates. Then it is necessary to pick statistical data which are to be visualized. The statistic data must be converted into the xml format by using the additional tools of program. Finally, they have to choose a basic thematic geographic layer (so called base geography). Among further optional steps are the selection of a topographic base and setting of visualization properties like color of legend, size of points or thickness of lines.

There are several templates that contain various composition components and their placement. Reports can thus have one or two map faces, a preview of entry inputs, tables of statistical indicators, or various types of graphs. It is also possible to adjust a result by selecting a template during the process of map creation, by changing a legend or adding a graphic element. Program works with three kinds of data – ESRI shapefile (SHP), MapInfo interchange file (MIF/MID), and MapInfo table structure file (TAB). InstantAtlas has been selected because it offers more possibilities than the other web maps. "Not only could its production be effected interactively, but more importantly, it is possible to keep link with a GIS statistical database" (Kraak, Ormeling, 2003).

Urban plans making within in the InstantAtlas

InstantAtlas has been used for the visualization of output of a project named *Research of Citizen Movement between Urban and Suburban Space in the Olomouc Region* (POHOS). The project consists of six partial activities that will bring new information about the citizen movement and utilization of individual parts of the region.

One aim of the project was to specify the boundaries between the urban and suburban space using methods DPZ and GIS supplemented with statistical indicators, evaluation of the spatial relations in the region as well as dominant directions of citizen movement. It is important to assess the data from both the short-term (everyday commute) and long-term (move) points of view. The results of the analysis serve as a basis for the prediction of development of the region and its future state.

Visualization is not only a final part of the project, but it will be used in all its partial activities. Overall visualized results are presented to the involved authorities and institutions (e.g. the Olomouc City Municipality) as well as to general public. A visualization of the results is focused mainly on the digital spatial data and thus on the creation of map outputs. A textual part of the results will, of course, cover visualization of non-graphic data in the form of graphs and tables. The map outputs will be published (presented) individually or in files as digital and analogue maps (POHOS, 2009).

In the POHOS project, the approach of semi-automatic visualization of analytical territorial data was used. Municipal plan documentation is one of the most frequently used documents in a Czech public administration sphere. For the majority of citizens it is (together with cadastral maps) the most visible and best-known official geographical document which they come across (Burian, Šťávová, 2009). Therefore it is viewed as natural and cultural value which is depicted graphically. Its arrangement, relations and individual designs are perceived as thematic maps (Šťávová, 2006).

"Many web-based thematic maps require the filtering of several selections on different pages. When the map finally appears, the user has little control over what is seen and how data is shown. To actualize digital cartography benefits, the thematic maps on the web should provide the user with selection capabilities based on theme, attributes, symbolization and classification. The user should be able to put maps on the same page" (Vozenílek, 2005).

InstantAtlas was used as a visualization tool because the data which are dealt with cover various topics. They give quantitative information about individual municipalities in different years. Concerning a conception of web map, reports give possibilities of a choice of visualized topics from a complex file, which is included on a single web page. With regard to a semi-automatic map creation, this dataset can be viewed as an ideal tool. Selected data comprise a lot of records of similar character that are repeatedly used for each year. Semi-automatic visualization of these data saves time and ensures a compact depiction of all data in just one format – a web atlas. Using the templates that contain a statistical comparison of regressive dependencies among the selected datasets, and the templates that enable monitoring of time series (e.g. graphs, tables) allows to investigate and compare the individual data in detail. It is very important for the project research especially taking into account the object of the research – citizen movement and spatial relation in the region.

Assessment of semi-automatic visualization within InstantAtlas

Although the InstantAtlas was during the preparatory phase of the project POHOS evaluated as the best software for the semi-automatic visualization, it does not mean that it meets all the requirements that the resulting visualizations were being made. Therefore, during its use, there were evaluated the pros and cons with the proposal of their possible solutions.

Main advantages include a general benefits of semi-automatic visualization – fast and efficient creation of recurring types of data sets. Specific benefits of InstantAtlas can include easy and user-friendly interface, possibility of creation new templates, simple and quick map updates, and easy publishing on the internet.

Among the disadvantages belongs mainly limited number of tools, which is additionally possible to import or program. These include limited options of legend settings and appearance of graphs and charts. Other disadvantages results from the very nature of semi-automatic creation of visualisations - it is a recurring error, a limited selection of topographic background, etc. Selected advantages and disadvantages identified during usage of InstantAtlas for the realization of project POHOS are summarized below.

Table 1: Selected advantages and disadvantages of semi-automatic creation of the visualizations in the InstantAtlas

Advantages	Disadvantages
Possibility to create individual legends	Limited possibilities to adjust a legend
Unified look	Cartographic errors caused e.g. by unified design or same legend
Prevention of cartographic errors and creation of a tool for semi-automatic visualization	Repeating errors
Suitable for repeating topics and data	Not possible to highlight the differences and rarities of individual datasets
Not necessary to create a topographic base	Important characteristic deviations may be lost
Quick creation	Limited choice of topographic base
Time and money are saved	Limited possibilities of data use
Easy and quick map actualization	
All the topics are on one web page	

Using of semi-automatic visualization in education

Semi-automatic visualization can be used in teaching at primary, secondary and high schools. For elementary school students can this program familiarize them with solving and spatial visualization tasks. In the context of geography teaching it can increase their responsibility for information technology, followed by a discussion of the results that can powers communicative competence.

The development of the educational content of subject Geography for secondary schools already meet the expected outcome when a student uses the available cartographic products, and other sources of geographic data to solve geographic problems. To achieve these outputs can be used semi-automatic visualization, that solve geographical problems through analysis and creation of cartographic outputs. Students can acquire the software works and other knowledge of databases, cartography, statistical or other fields.

In college, students may use the software completely independently on the basis of requirements for implementation of their own outputs and solving problems. The software can be used not only to students of geographical disciplines, among them students of political science, economics, etc.

Advanced Processing of InstantAtlas Outputs

When assessing an interactive map, mainly a composition of the map is considered (Veverka, Zimová, 2008). The composition covers setting, graphical depicting and positioning all basic and upgraded composition elements. It also includes setting both map face and complementary map elements like explanatory notes, citations and others. A title, legend, map scale, map imprint and map face are the basic composition elements of a map (Vozenílek, 2004). These elements must be contained in all maps with the exception of map files like state map works. The composition of a basic report in InstantAtlas (see fig. 1), however, does not cover all the basic composition elements of a map (e.g. a map scale and map imprint). The users therefore should be experienced cartographers who are capable of adding the missing elements. In case of a map scale, they add an automatic interactive element which adapts to a zoom of a data view. A map imprint, which contains information about an author, date and place, can be inserted as a map face. The users should also pay attention to the composition elements of the report. A map title should contain factual, spatial and time information about the map. An automatically generated map title, however, is based on the data structure and therefore it does not allow for adding all the information needed. Considering the interactivity of reports, it is not possible to change a thematic component, the problem is hard to solve. The most feasible solution is to create a general title as a textbox and an automatically generated title as a subtitle. An automatically generated legend is based upon the structure and format of data. A legend title is thus created by a title of a data layer and, unfortunately, it does not comprise numeral data. A map face is interactive and its zoom and size can be modified. Moreover, when selecting the map elements, the additional elements like graphs and tables alter. An important role of the map face in reports should therefore be considered.

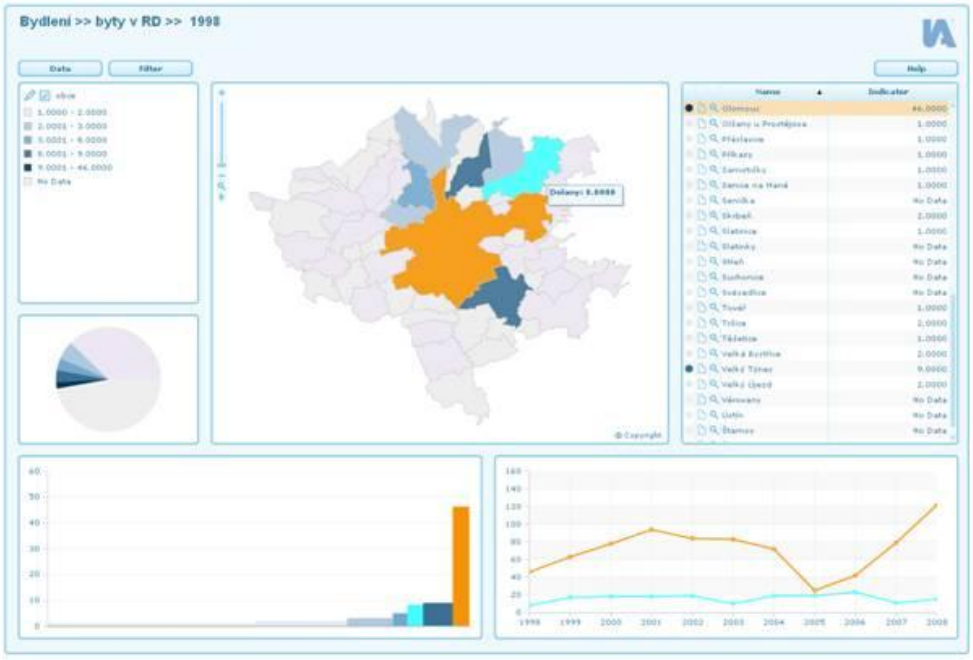

Fig. 4: Example of wrong cartographic visualization of data from the POHOS project: Living in Houses in 1998.

The most frequent upgraded composition elements in a report are tables, graphs and figures. Nevertheless, the form they have in a basic report fails to meet the requirements of a professional output speaking mainly about a title, description of graph axis, graph legend etc. As to the automatically generated circle diagram, it does not start in a vertical axis, but it is turned through 90° as required by the Anglo-American rules. What is more, the sector values are not arranged from the biggest to the smallest, which would be correct, but they are randomly arranged according to their data structure. This problem, however, is not solvable because of the interactivity of the report. Another weakness is the absence of a title and legend in diagrams.

Some of the above mentioned weaknesses can be excused with regard to a fact that InstantAtlas is primarily used for publishing data on the Internet, not for creating printed outputs. An experienced user, however, should try to avoid cartographic errors in a final report as much as possible (see fig. 2 – an example of error correction).

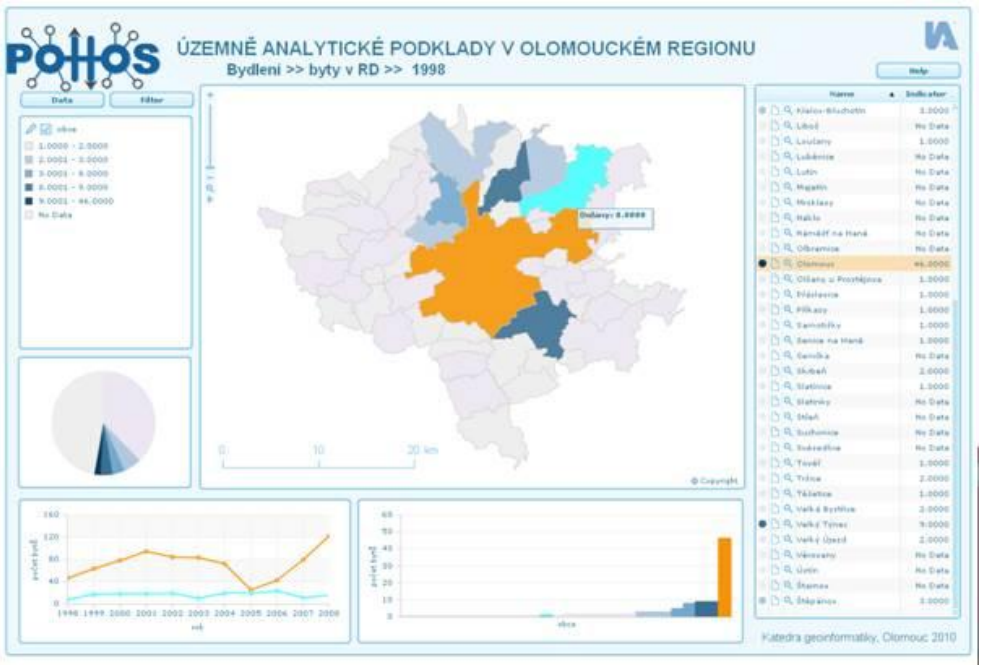

Fig. 5: Example of correction of errors in visualization of data from the POHOS project: Living in Houses in 1998.

Conclusion

Semi-automatic data visualization is the convenient tool for professionals who want to show data which are in the form of time series or of data whose character is identical in the form of graphical output or maps. The main advantages of this processing method are saving of time and money, as well as easy actualization.

For professionals who are not cartographers and do not work with geographic information systems InstantAtlas is a unique tool that allows them to create simple calculations, analyses and presentation of spatial and attribute components of their data. The advantages of using semi-automatic visualization of a purely automatic data processing or the processing of a fully autonomous and completely original outweigh the minor flaws, including the limited possibility of setting individual composition elements of final visualization, repeating errors and an absence of information about differences and rarities of individual datasets.

The use of automatic or semi-automatic visualization is especially suitable for familiarization with dataset content since the user gets in a short time the information about data structure, their extent and variety of their attributes. For the vast amount of data that occur in the physical and socio-economic geography as well as in other fields of science, it is a very effective way of presenting data.

InstantAtlas has been chosen as a convenient tool for visualization of input data of the POHOS project and based on its usage, it can be said, that it is a very beneficial program for publication of statistical data in the form of dynamic web maps for users who are not specialists on cartography and geographic information systems and do not have too much experiences in his area.

There are quite a large number of accessible templates. However, to gain a high-quality cartographic output, it is necessary to modify a final output according to the cartographic principles and rules. Most

importantly, there is need to add some missing basic and upgraded composition elements like a map scale, map imprint, well-structured legend, and map title containing factual, spatial and time determinations. Apart from this, correct graph descriptions and diagram orientation must be adjusted, and the attributes which are encoded in the tables must be adapted.

Automatic and semi-automatic visualizations are popular tools for spatial data processing mainly because they save time and are very user-friendly. Based on the evaluation of its functionality and the experience gained by work with various programs offering automatic and semi-automatic visualizations, InstantAtlas can be regarded a high-quality product.

This paper was supported by the student project PrF _2010_14 of the Palacky University "Research of citizen movement between urban and suburban space in Olomouc region".

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