

# INFORMATION AND ANALYTICAL WEB MAPPING SYSTEM "MAP OF HEALTH CARE OF KRASNOYARSK REGION"

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**Abstract.** Approaches to the modern geoinformation web-systems development and technological features of software implementation are considered, their development trends are discussed. A brief description of the web 2.0 technologies main components is given, the use of which provides the current level of web mapping. Goals and objectives, the main purpose of the formed region's health management informational support system based on mapping web-interface are formulated. A general characteristic of the created software is given, some aspects of its implementation and program architecture are discussed. User interface construction features are discussed using several examples.

## 1 Introduction

Geographic Information System is a useful tool that aids and assists in health research, health education, planning, monitoring and evaluation of health programmes that are meant to control and eradicate certain life threatening diseases and epidemics [1]. To a large extent, recent years advances in the geographic information systems (GIS) software are related to web technologies. Due to them, an opportunity of access to high resolution satellite images and other data of significant volume appeared, which is displayed on the map and available via web services – city streets photos, operative situation on the roads (traffic jams), weather, emergencies, fires, etc [2]. We can also say that today a new generation of geographic information systems is created using the paradigm of "Web 2.0" technology in addition to traditional mapping applications, whereby more and more significant role is played by end-users, who cooperatively create and update the content of these systems through social networking mechanisms. The considered trends became especially intense in recent years with the growing popularity of mobile devices with geolocation capabilities (smartphones and tablets). At the same time, it should be noted that this area is still being formed and many aspects are not defined and settled yet. A search for optimal solutions goes on in the field of construction and architecture ideology for the distributed GIS software, data access mechanisms, their respective structure and organization, program interface development and data exchange standards, user interface

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[3, 4]. The existing software analysis in the considered area shows that the geoinformation web-system can be implemented in various ways today. Currently, numerous software developments appear – from simple visualization means for the prepared maps in the browser to complex systems of corporate geospatial information processing in distributed computing environment [5].

In this context, attention should be paid to the fact that a modern trend is to create and implement applied geoinformation web-systems focused on information support for dealing with problems in various areas – governance, environment and natural resources, transport and communications, education, etc. Such a system designed to provide health care control in the region will be considered below [6]. Similar decisions are made today in different countries [7].

## **2 Mapping web-systems technologies**

Information-analytical mapping web-system "Map of health care of Krasnoyarsk region" considered in this article is based on so-called "Web 2.0" technology. This term describes a stage in the Internet development, which involves the use of the following components on the contrary to the old "Web 1.0" technology:

- Web services – platform-independent applications, which are accessed via HTTP protocol, and the data is exchanged in XML or JSON format. As a result, the produced software can use the existing web services instead of performing the required functions again.
- AJAX – an approach to interface building, under which a web page downloads the required data asynchronously without rebooting.
- Web syndication – a mechanism of information dissemination to different pages or websites, usually with the use of RSS.
- Mash-up – a service that completely or partially uses other services as sources of information providing the user with new functionality.
- Tags – keywords that describe the analyzed object or correlate it to a certain category. They are used in blogs.
- Socialization – community creating tools: personal site settings, personal files and photos collections, blogs, etc.

Describing this class of geoinformation and mapping web-systems and services (web-GIS), it should be noted that spatial data processing, distribution and exchange capacity offered by modern web-mapping means generally correspond to the above list of "Web 2.0" features – these are interactive functionally-rich web applications with the content dynamically formed by users. There are a number of such kind systems nowadays [8]. They are adequate to technical possibilities of the Internet - availability, access speed [9].

The use of "Web 2.0" concept in the web-GIS implementation provides an unprecedented level of geospatial technologies democratization. Previously, for example, the formation of cartographic GIS-project data array was performed only by professionals using complex applied systems such as ArcGIS. Today, users upload their own information about road accidents to car navigation systems, draw their maps (OpenStreetMap, Yandex people's map and so on), use mapping services (API Yandex.Maps, Google Maps, etc.) to create personal mapping web interfaces – from a simple web page with an interactive map "How to find us?" to a complex portal with multicriteria spatial queries. A powerful impetus to the web-GIS development and their widespread use was the recent emergence and rapid development of various personal mobile devices with built-in means of satellite positioning and Internet access – netbooks, smartphones, tablets in addition to laptops/ultrabooks [10].

For some functionally rich web-GIS, the term "geoportal" is commonly used. The geoportal is a type of web portal used to access and search for geographic (geospatial) information and related geographic web services (access, editing, and so on). It is one of the spatial data infrastructure key components. The geoportal functionality is closely associated with metadata management subsystem, means of spatial analysis, interactive visualization. Usually, its systemic basis is traditional software and technologies for web content management systems (CMS) [11].

### **3 Cartographic web-system for health management information support**

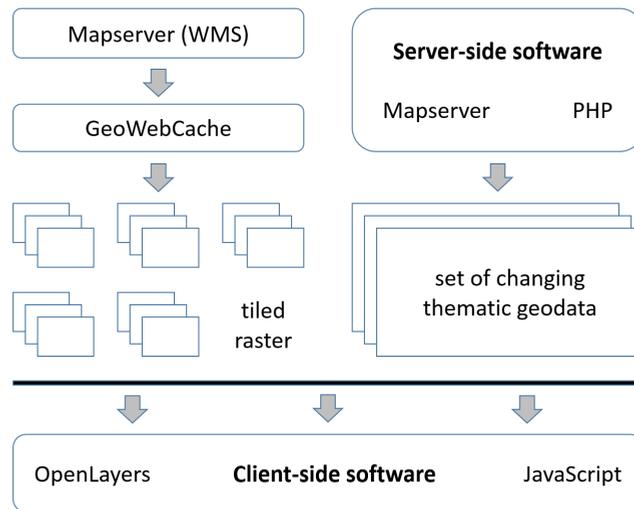
The classical scheme of data publication in the Internet involves the use of additional software tools for creating graphic images and/or html-reports. A disadvantage of this approach is inability to edit the published data directly, increase of labor costs and publication time, dependence of users on third-party software. In the case of geospatial data web publishing, the situation becomes even more complicated [12, 13].

In the process of web-system "Map of health care of Krasnoyarsk region" designing and developing, a series of practical experiments was conducted, in which different versions of software for publishing geodata on medical institutions were tested. In particular, tools for the formation of interactive thematic mapping information were created without the involvement of specialized geoinformation system software to solve this problem. Instead of professional GIS, data preparing and modifying was used directly through the management subsystem web interface, which is successfully used in today's popular web content management systems [14, 15].

As a result, we have got an efficient and flexible solution that does not require involvement of commercial GIS, which also can be maximally adapted to the problem being solved [16]. The application provides possibilities of distributed multi-user editing of spatial data display style, its dynamic changes based on the values of the corresponding database tables.

In technological terms, the proposed web interface of geospatial data editing is an HTML/JavaScript script, which contacts the PHP handler for additional data and graphic images through AJAX queries. In turn, the PHP handler performs the server side operations, accesses the database and mapping servers and generates data arrays and images, which are then returned to the HTML/JavaScript interface as a response to the asynchronous query. The end user does not see these operations perceiving them as visual editing of the graphic object in the system editor window [17].

The cartographic web interface uses a number of cartographic information forming methods for the user. The first method is map displaying with the use of fragments (tiles). This technology is used by such resources as Google Maps (<http://maps.google.com/>), Yandex Maps (<http://maps.yandex.ru/>), Virtual Earth (<http://www.bing.com/maps/>) and others [18]. The main advantage of this method is the speed of visual information receiving by the user and low server loading during static information displaying. The process of map formation in the client computer consists of several steps using additional program streams, caching, fragments downloading queue, etc. Under this way of map displaying to the user, the map constructing process allows to optimize the downloading process, reduce the web browser load and distribute it more evenly over time. However, when displaying the changing thematic data, this method reduces the speed of the user access to spatial data and increases the server load. To solve this problem, another method of information displaying is used – a single bitmap image is generated by the user's query. Depending on the type of information provided to the user, the system interface uses a combination of these two methods (Figure 1).



**Figure 1.** Map formation technology in the client web application.

## 4 The territorial health resources database

Formation of information-analytical software for the Krasnoyarsk region health management began about 20 years ago. Krasnoyarsk Regional Medical Information and Analytical Center (KMIAC) was established in 2002 performing the functions of integrator in the field of information technologies for the health care system of Krasnoyarsk region; a number of key information systems was developed and introduced into practice.

Within the gradual creation and development of the Krasnoyarsk region system of health and medical insurance, a geoinformation web-system – territorial database of health care resources in the region – is developed since 2008. Its main task is development of an optimal perspective scheme of access to health care for the region residents. Main purposes of the system are:

- professionals and public authorities informing;
- information support for local governments;
- health facilities professionals informing;
- information support for the regional ministry of health employees;
- informing the public about the health care resources location.

This system is a tool to improve the health service quality [19]. The territorial health resources database contains information on all municipal and regional health facilities (over 200 items), health care objects (over 1300 items), about 130 performance indicators for the health care facilities, demographic data, morbidity, a medium-term development plan for the health care institutions network. There are a number of similar system around the world [20–22].

Today, the considered geoinformation web-system is one of the common information space elements of the Krasnoyarsk region health system. All data presented on the map are generated automatically as a result of medical information centralized repository data aggregation. Integrated data can be used to solve various analytical tasks [23].

The system works steadily for more than five years; its maintenance and regular data updating is carried out by KMIAC.

In particular, it is possible to analyze changes in the departmental network of medical institutions – different icons on the map correspond to converted, liquidated and created obstetric centers, clinics and other medical facilities. Any departmental statistics can be

presented as a thematic map with automatically generated descriptions (color scales) in the context of municipalities. Data filtering and exporting are also provided.

## 5 Conclusions

Experience of the developed information-analytical mapping web-system "Krasnoyarsk region health map" practical operation proved the effectiveness of proposed solutions. Professionals and interested users have an opportunity of operative access to the relevant data on the regional health care system. The branch managers and system analysts got a modern tool for the situation analysis and management decisions preparation. Information about the health care resources location is interesting for a wide range of users.

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