

On Some Approaches to Creation of the Complex Universal System Supporting Laser Express Expertise

Lada Rudikova

Educational Institution «Grodno State Yanka Kupala University», BELARUS, 230023 Grodno, ul. Ozheshko 22, rudikova@gmail.com

Abstract: *General approaches to creation of the universal complex system supporting various aspects, related to laser express expertise, are considered in the article. The data model and the functions model are obtained, as well as the generalized architecture of the proposed Internet system, which is based on interaction of services, is developed.*

Keywords: laser express expertise, complex universal system, the data model, Internet system, the service-oriented architecture.

1. INTRODUCTION

Nowadays laser methods of the analysis of structure of soil, ores, minerals and related materials are actively developed, extensive material on spectra is accumulated, which is indicated by corresponding tables and atlases of spectral lines of chemical elements (see, for example, [1-3]).

By the current moment there is no required software which not only supports the cycle of works connected with carrying out of this or that expertise in subject domain, but also carries out storage, search and processing of the accompanying information.

Thereby detection of corresponding requirements to the software for support of different stages of work in the area related to laser express expertise, as well as its development, approbation and optimization, is urgent.

The principle propositions necessary for development of complex system of data storage, processing and analysis are given in this article.

2. ABOUT THE BASIC REQUIREMENTS TO CREATION OF COMPLEX UNIVERSAL SYSTEM

So, let us consider the basic aspects of subject domain necessary for realization of complex system which supports laser express expertise. It is assumed that the developed system is universal and will serve for coordination of actions of various researchers, and also accumulate, store and process the information on demand of the researcher-expert.

First of all, the projected system should contain the information on those objects which are exposed to express expertise, with objects being able to be various enough: from some works of art which are in private collections, to economic complexes which, for example, are subject to corrosion and destructions. It is necessary to notice also that the presence of several spectra, which are registered in various points of object, is possible for each object. Moreover features of laser spectrometry and also available bases for spectral lines of chemical elements will be considered in system.

Each researcher-experimenter who will work with the system has to login and specify the demanded data: surname, name, patronymic, e-mail address, phone

numbers, as well as login and password. Let's notice that users of system possess various privileges.

As it was specified above, the main objects of system are investigated samples. Thereby the system will store the extended information on them which reflects following aspects: the object name, its description, type, category, the object photos, the expertise document, date of research and some other data.

During the object research it is also desirable to add the information on its owner as well who can be both legal and physical person.

It is necessary to record the information on the organization (if it is a question of legal person) to which owners of objects of expertise and researchers-experimenters belong, the country, the city, etc.

One should also consider some peculiarities. Each of the investigated objects can possess several spectra. Researchers-experimenters have to belong to scientific or other organization. When entering the city of the owner or the researcher-experimenter it is also necessary to specify the country and the corresponding region according to the administrative division of the given country.

While recording the spectra of investigated samples one should store the deciphering on chemical elements as well as consider the specificity of research implementation.

The following groups of users will have access to the universal complex system which supports the laser express expertise carried out for various objects: the system administrator, researchers-experimenters, users and some other types of users whose rights are appointed by the system administrator.

3. DATA MODEL OF COMPLEX UNIVERSAL SYSTEM

Upon studying the subject domain and the corresponding possibilities of development and updating of universal system the conceptual data model, which is to become a basis for gathering and storage of data related to laser express expertise, has been built.

Let's mention the main entities of the data model: generic user (GenericUser), researcher-experimenter (User), owner (Owner), research object (ResearchObject), object photos (ObjectsPhoto), type of research object (ResearchObjectType), category of research object (ResearchObjectsCategory), privileges (Privileges), organization (Organization), city (City), spectral research (SpectralResearch), spectrum (Spektr), chemical element (ChemicalElement), state (StatesOfMatter), crystal structure (CrystalStructures), isotopes (Isotope).

The conceptual data model realized by means of Power Designer is presented on fig. 1.

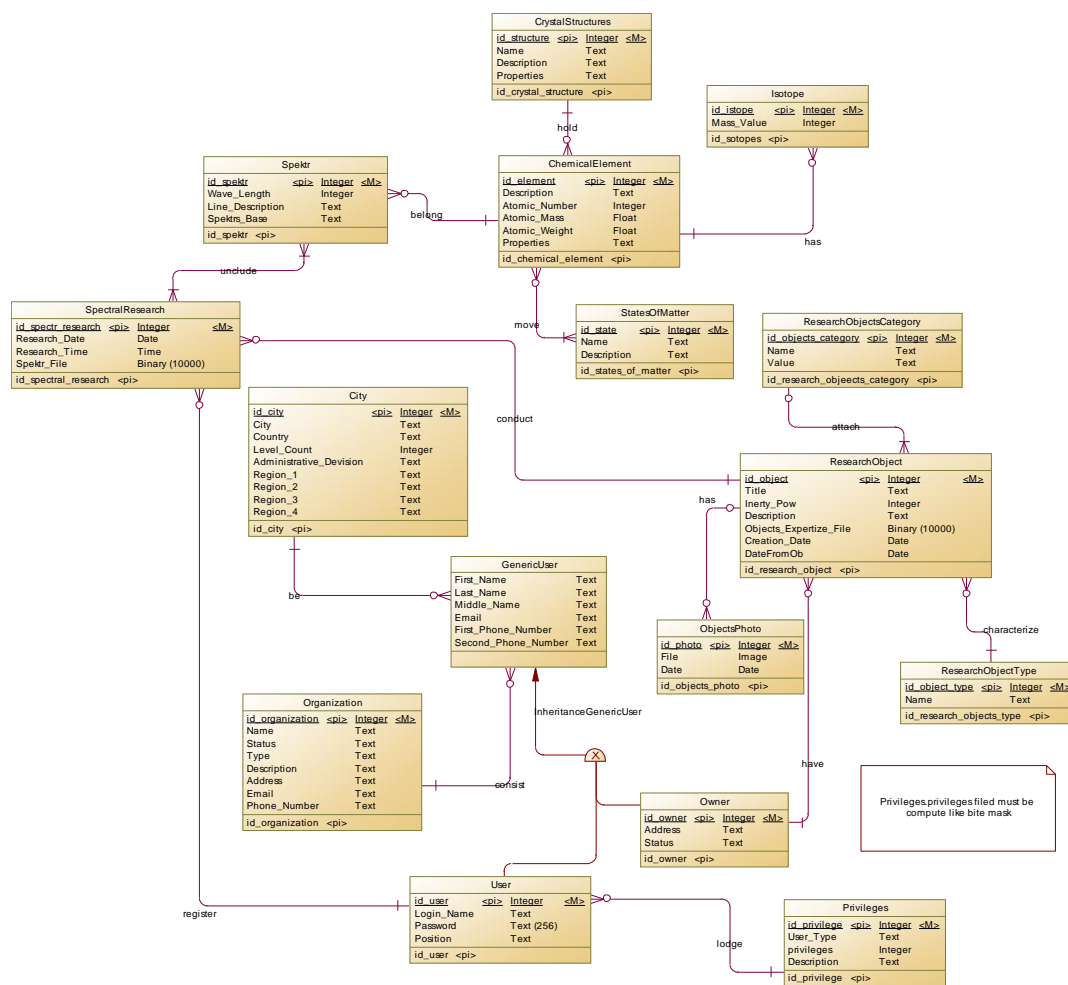


Figure 1 – Conceptual database model

4. ON SOME ASPECTS OF FUNCTIONS MODEL FOR COMPLEX UNIVERSAL SYSTEM

The functional model which takes into account the necessary features of the offered software was also proposed for the developed complex universal system supporting the various aspects of laser express expertise. We will notice the individual aspects of system functionality later.

The basic functions of complex universal system are displayed on the diagram of use cases (Use Case Diagram) (see fig. 2) and cover the functions of the Administrator, Moderator and User.

The Administrator functions. It is obvious that the main task of the Administrator is system administration.

Administration includes such functions, as: modification of metadata; search, viewing and modification of data; appointment of users that in turn includes such problems as appointment of moderators and appointment of users.

Except the functions listed above the Administrator is engaged in administration of database and the application itself.

Modification of metadata is carried out through the integrated interface of database control system (DBCS).

The Moderator functions. The moderator should possess rights to use system.

From here functions similar somewhat to the functions of the administrator follow, namely: search, viewing and

modification of data; appointment of system users.

The Administrator and the Moderator carry out functions of operation with data through the same user interface - the application form.

Except the mentioned functions the Moderator possesses also the function of the data analysis which allows him to receive a certain result, statistics or realizes the possibility of data search within the limits of the user representation.

The data analysis can be expanded by appointment of a necessary technique of data analysis or presentation.

The Moderator can see the analysis results through the analysis results form interface.

The User functions. The main function of the User is to work with the system. The user can conduct the required data analysis; appoint a technique of data analysis and presentation; carry out search and browse data within the limits of the user representation; edit the personal data.

All functions are accessible to the user through the private office interface.

Let's notice as well that during the analysis of proposed system functionality other diagrams necessary for reflection of those or other aspects of system activity where also obtained, in particular, the sequence diagram (Sequence Diagram), state chart diagrams (Statechart Diagram) etc.

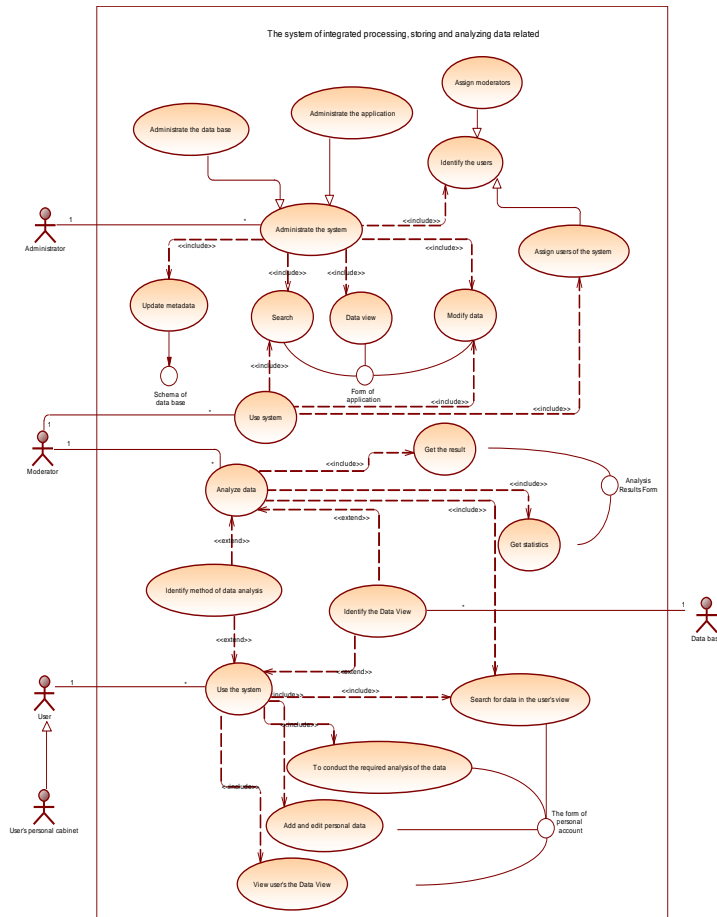


Figure 2 – The diagramme of complex universal system use cases

5. THE GENERAL ARCHITECTURE OF THE COMPLEX UNIVERSAL SYSTEM SUPPORTING LASER EXPRESS EXPERTISE

The developed system is an elaborate Internet-complex consisting of individual functional modules. Each module embodies the certain (individual in its way) logic of operation with data, its processing. Thereby the service-oriented architecture, in which each link (service) can function independent as well, is proposed for projected system.

The proposed architecture allows organizing the distributed data processing by deployment of services on individual physical machines that makes it possible for each service to use the highest possible machine computing resources. However some degree of complexity and inconsistency can arise at the organization of loading balancing between several services of certain purpose.

Generally the skeleton for system functioning is based on interaction of services (fig. 3).

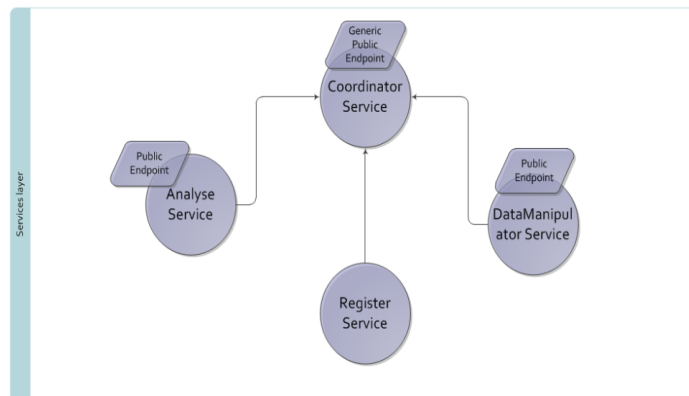


Figure 3 – The interaction of services within a universal system

Coordinator service (Coordinator Service) gives a final point (contract) for interaction with system. The specified coordinator, first of all, is responsible for the

loading organization between child services and granting of the interface to the customer.

Analytical service (Analyse Service) implements the

functionality and logic of the received research data analysis. Herewith it is possible to quickly and easily extend the functionality by adding new methods of data analysis.

Registration service (Register Service) encapsulates the logic for the registration of various data in database (repository) including the registration of system users as well.

Data manipulator service (Data Manipulator Service) prepares data from the database (repository) for the end customer. Through specialized manipulations of raw data, the customer receives the demanded data in the most required and preferred format.

However, it should be noted that, in general architecture (see fig. 4) is organized in the form of independent, autonomous, weakly-connected layers. Each layer has a well defined logic and functionality.

Data access layer hides all logic of processing and interaction with the database (repository). For the upper layers it provides a generic and intuitive interface.

A layer of business logic generalizes within itself logic of data processing, analysis and manipulation. This layer can be considered as main since the basic behavior

of the system is laid down in it. This layer provides contacts for services.

The decomposition into independent layers enables the possibility of easy and quick modifications that directly extends system functionality.

Due to the placement of general coordination service over a layer of business logic, acting as a result in a role of a conditional facade, the system provides the possibility to organize public access to the capabilities of the system through API-system.

As a result of this approach for the end user various implementations of client applications are possible, from desktop applications to mobile versions of the system.

It is of great importance for the availability of the system and its distribution.

We also note the following aspects related to the possibility of deploying the system:

- self-organization of the entire infrastructure, using their own computers;
- use of services of third-party companies that provide a platform for the deployment of such systems with service-oriented architecture.

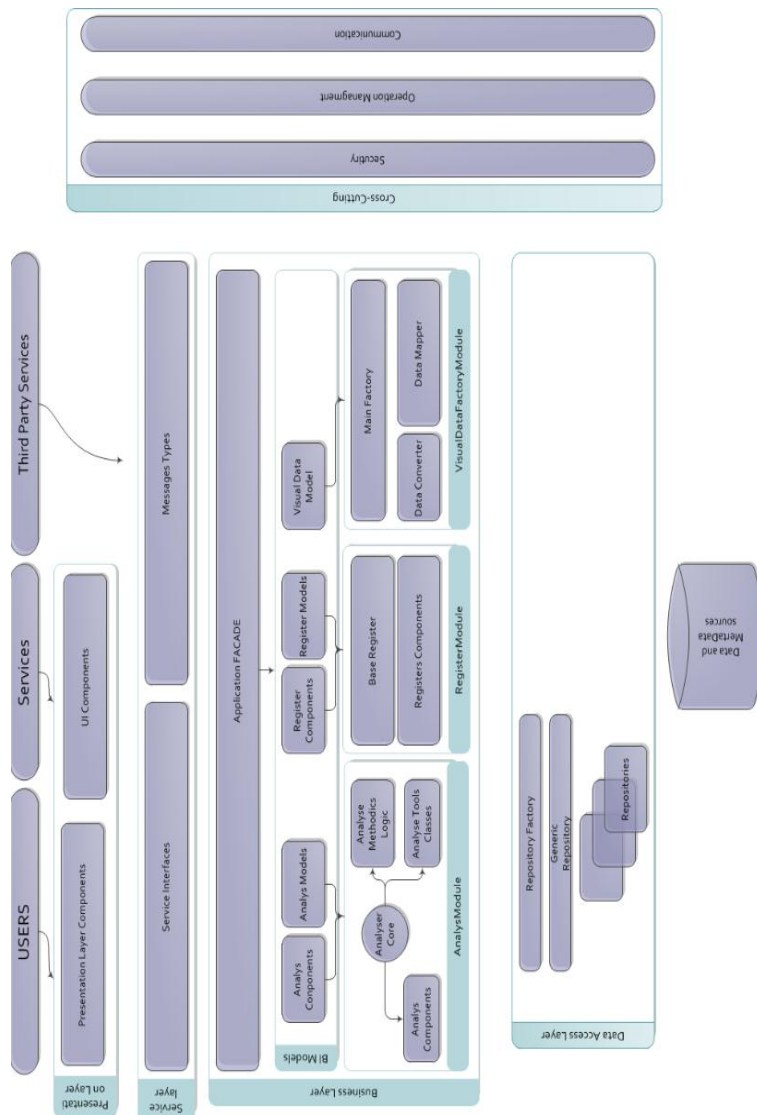


Figure 4 – The overall architecture of a universal system

6. CONCLUSION

Thus, the main requirements to the software that supports the carrying out an express laser expertise are the following aspects. First, support for digital databases of major chemical elements, visualization of the main lines of frequency spectra, as well as processing data related to the materials research expertise and study of technological products, historical and artistic values, objects of the environment, biostructures. Second, the development of an appropriate universal system that will make it possible to automate the processes of storing, retrieving and analysis of data of materials research expertise for the purpose of their further processing and obtaining the required expert judgments.

On the other hand, the automation of various aspects related to laser express expertise will allow collecting the necessary results in a database for their further processing, visualizing and scaling the spectra obtained, as well as perform the necessary analysis of the results of expert judgments carried out. Of course, all of this will contribute to increased use of mobile laser spectrometer, increase its competitiveness in the global market of corresponding expert devices as well as the software that supports the executing of express laser expertise.

The proposed system will contain the necessary data related to various aspects supporting express laser expertise, as well as offer the possibility of accumulation of a variety of information about the conducted expertises and research objects. In the future this will allow creating some universal system of support of decision making in the field of laser express expertise, which, undoubtedly, is of the scientific and practical interest for both the Republic of Belarus and the world's scientific and research centers engaged in expertise of the chemical composition of solid-state elements.

7. REFERENCES

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