Central Asian Problems of Modern Science and Education

Volume 4
Issue 2 *Central Asian Problems of Modern Science and Education 2019-2*

Article 69

7-15-2019

PRINCIPLES OF AUTOMATION OF PROCESS ACCOUNTING AND CONTROL DEVICES OF RAILWAY AUTOMATICS AND TELEMECHANICS

D. Kh. Baratov
Tashkent institute of railways engineers, baratovdx@yandex.ru

UDC: 004.021+656.25

PRINCIPLES OF AUTOMATION OF PROCESS ACCOUNTING AND CONTROL DEVICES OF RAILWAY AUTOMATICS AND TELEMECHANICS

Baratov Dilshod Khamidullaevich
Ph.D.,Tashkent institute of railways engineers,
Tashkent, Uzbekistan,
Email: baratovdx@yandex.ru

Annotatsiya. Maqolada temir yo‘llarni avtomatlashtirish va masofadan turib boshqarish (signalizatsiya, markazlashtirish va blokirovka) qurilmalarini hisobga olish va nazorat qilishning avtomatlashtirilgan tizimini ishlab chiqishni funksional ta’minoti masalalari yoritilgan; tizimning elektron-ijro etuvchi qismlarining komponentlari ko‘rsatilgan; kontseptual model taklif etilgan va ishlab chiqilgan avtomatlashtirilgan tizimni loyihalashning xususiyatlari tavsiflangan.

Kalit so‘zlar: temir yo‘llarni avtomatlashtirish va masofadan nazorat qilish tizimlari, signalizatsiya, markazlashtirish va blokirovka qurilmalari, elektron ijro etuvchi qismning komponentlari, kontseptual model va avtomatlashtirilgan hisobga olish va nazorat qilish qurilmalarini loyihalash.

Аннотация. В статье рассмотрены вопросы функционального обеспечения автоматизированной системы учета и контроля устройств железнодорожной автоматики и телемеханики: сигнализации, централизации и блокировки; представлены компоненты электронно-исполнительной части системы; предложена концептуальная модель и описаны особенности проектирование разработанной автоматизированной системы.

Ключевые слова:система железнодорожной автоматика и телемеханика, устройства сигнализации, централизации и блокировки, компоненты электронно-исполнительной части,концептуальная модель и проектированиеавтоматизированной системы учета и контроля устройств.

Annotation. The article deals with the issues of functional support of the automated system of accounting and control of railway automation and telemechanics devices: signaling, centralization and blocking; the components of the electronic Executive part of the system are presented; the conceptual model is proposed and the design features of the developed automated system are described.

Keywords: system of railway automation and telemechanics, signaling devices, centralization and blocking, components of electronic Executive part, conceptual model and design of automated system of accounting and control of devices.

Introduction

The introduction of advanced information technologies for the digitalization of the entire transport system, the development and implementation of long-term development strategies is one of the main tasks of the transport system [1].

The widespread introduction of computing tools in railway automation systems of telemechanics (RAST), providing a significant increase in the volume of transmitted and processed information, the development of the functional possibilities of systems requires the use of new approaches to the organization of document management of technical documentation.

The application in devices of signaling, centralization and blocking (SCB) of various types of automated workplaces, automated control systems, as well as elements of increased reliability, schemes of their backup and duplication in signaling creates prerequisites and is the conditions for the transition to the repair-recovery technology of maintenance in which the work is done: regulations, as [2-3]. The use of repair and restoration technologies for certain types of SCB equipment will allow: to improve the safety of train traffic and the efficiency of traffic management based on the high reliability of the serviced devices; to ensure the implementation of additional organizational and technical measures to improve the safety of train traffic

by reducing the specific labor intensity of maintenance and increasing productivity [4-6].

Further automation of control parameters of devices using digital and analog signals will allow to switch to the recovery technology of service of almost all elements of the technical means of the SCB. At the same time, an important place will be given to the reservation and use of highly reliable elements with extended service lives equal to or close to the service life of electric centralization systems, automatic blocking, dispatching centralization, etc.

Currently, part of the technical means has developed a service life or is approaching it (in SCB devices this is about a quarter of the existing ones). In order to prevent further aging of devices, employees of signaling and communication have to significantly increase the pace of modernization of technical means in the coming years. At the same time, should be introduced newly developed domestic and foreign systems of electric centralization, automatic blocking, dispatching centralization on a microprocessor basis.

At the same time, it is necessary to switch to new modern service technologies. The task is to automate the maintenance of devices as much as possible due to technical progress, to minimize the probability of the negative impact of the human factor on the process of ensuring the failure-free operation of technical means and, as a consequence, on the state of train safety [7]. Given the fact that it is currently impossible to 100% complete the production of highly qualified and responsible performers, the task is to ensure the centralization of control over the state of the technical means and the correctness of the actions of the performers.

Specialists of signaling and communication play a special role in improving the efficiency of the industry and ensuring the safety of train traffic. The successful solution of problems will be facilitated by the creative interaction of the workers of this most complex production and technological complex.

For the organization of the accounting of devices of railway automation and telemechanics, tracking of their movement and operational identification it is offered to use the automated system of the account and control of devices of SCB.

1. Description of the automated system of accounting and control of devices RAST

Automated system of accounting and control devices is intended for automation of accounting and control devices of railway automatics and telemechanics, as well as for planning works of the repairing-technology area (RTA) or control-measuring point (CMP).

The creation of ASA-CDRAT is aimed to improve the quality and efficiency of work on the replacement and repair of SCB devices, the validity of decision-making by specialists and managers of the distance of signaling and communication SHCH, the administration of signaling and communication SH, and laboratory automation and telemechanics SHL by automating the processes of planning, optimization and control of execution of works.

The automated system is used in distances of automation and telemechanics of the railway. Main functions of the automated system:

- creating and maintaining the database, including the passport of the specific instrument and information about the location of their installation;
- escort of displacement of devices in connection with periodic replacements, disposals, acquisitions, etc.;
- planning the replacement of instrument with issuing technologically necessary information;
- the monitoring of implementation of plans of replacement devices;
- failure analysis of devices of signaling, centralization and blocking;
- work planning the repair-process areas;
- issuing of the output documents, search capability of the devices in the database according to arbitrary queries.

The tasks and functions performed by ASA-CDRAT are given in table 1.

Table 1

The tasks and functions performed by ASA-CDRAT

Functions	Content	Periodicity
1 task. The initial data entry about devices.		
1.1. Input data	The initial data entry about devices with the decomposition by stations, tracks, locomotives, employees	During installation
1.2. Formation of references	Review and printing of operational informations about the location of the devices.	On demand
2 task. Accounting and control of movement of devices and their technological condition		
2.1. Accounting for the receipt of new devices at a distance	The entry in the database of ASA-CDRAT data about devices, newly entered the distance (in exchange fund RTA).	Upon the event
2.2. Accounting write-off of the devices	Data input on the write-off of the devices with the formation documents for the cancellation (from exchange fund RTA).	Upon the event
2.3. Accounting for the output of devices from the repair	The fixation data about performance works of the verification and repair devices taking into account fulfillment of plan tasks by the workers RTA. Formation of data about reclamations in the case of checking the newly received devices.	Daily

2.4. The account of planned replacements of devices	Fixation of data in the database about movements of devices from RTA to the line and back on the basis of information of the brigades of complex replacement or linear mechanics.	Upon the event
2.5. An accounting of replacement by the failure	Fixation of operational information about failures of devices with the formation of data.	Upon the event
2.6. Inventory replenishment accounting	Fixation of information about the movement of devices from the RTA to the stock.	Of necessity
2.7. Account of preservation of devices	Fixing the temporary withdrawal of the instrument from the work and returning them to normal production cycle.	Of necessity
2.8. The account of dismantling of devices	Fixation of dismantling of devices and (or) places of their placement.	Of necessity
2.9. Accounting for the movement of devices between the exchange fund and the warehouse	Fixation of input of devices long-term storage in the technology replacement through the exchange fund and the reverse procedure.	Of necessity
3 task. The planning of works of RTA		
3.1. The formation of plans	Formation of plans for a month, year or arbitrary period taking into account calendar terms of replacement or actually worked out resources (on the basis of simulation modeling).	According to the regulations and request
3.2. Optimization of plans	The formation of the optimal plans for	According to

	the replacement of devices.	the regulations and request
3.3. Adjustment of plans	Manual adjustment of plans for replacement of devices.	According to the regulations and request
3.4 Getting the output of documents on plans	Receipt of documents and their archives according to plans.	According to the regulations and request
3.5. Formation of plans for repair and inspection of devices in the RTA	Formation of plans for repair and inspection of devices, taking into account the plans, completeness of the replacement, the availability of staff of the RTA and the exchange fund.	According to the regulations and request
3.5.1. Optimization of plans for the repair and inspection devices	Formation of the optimal plan for repair and inspection of devices in the RTA, taking into account the technology of inspection, qualification of employees, unscheduled works, etc.	According to the regulations and request
3.5.2. Adjustment of plans for repair and inspection of devices	Manual adjustment of individual planning tasks by the employees of RTA for repairing and inspection of devices.	According to the regulations and request
3.5.3. Obtaining output documents by individual planning tasks	Obtaining documents from archives for individual planning tasks for repairing and inspection of devices.	According to the regulations and request
4 task. Formation of normative documents and documents of arbitrary form for users of the distance of signalling and communication SHCH, management of the signalling and communication SH and the laboratory of automation and		

telemechanics SHL		
4.1. The formation of queries	The formation of user queries on the data reception and response to facilitate the exchange of data between databases of different levels of management (SHCH,SH, SHL).	Daily
4.2. Formation of documents of the established form	Balance data and its derivatives.	On request
4.3. Formation of documents of an arbitrary form.	Formation of documents and screen forms with the set of columns selected by the user on a variety of data about the devices stored in the database ASA-CDRAT on the road and distance levels.	On request
4.4. Formation of documents for failure analysis	The formation of the technical conclusions of failure analysis.	Upon the event and on request
5 task. Service support of the complex		
5.1. Maintain and view of catalogs	Work with reference books: types of devices, employees of RTA, distance objects, stock composition, force restart all the manuals.	On request
5.3. SOFTWARE configuration, help	Editing user settings for working with the program. Show help for the program. Work with open windows in SOFTWARE. Provides the ability to view user access rights to SOFTWARE functions. Calls the	On request

	automatic update of the SOFTWARE version.	
5.4. Working with duplicates devices	Provides functionality to detect duplicates of devices in the database.	On request

For the functioning of the ASA-CDRAT requires a personal computer with the following characteristics:

- IBM - compatible personal computer at least Pentium III 550;
- RAM / operation memory / at least 128MB;
- Free HDD /hard disk space/ at least 30 MB;
- Local or network

2. Components of the electronic Executive part of the system

The functioning of ASA-CDRAT based on the use of the special program — server document-flow. The server performs the main functions that ensure the work of users: search for equipment from the database, report on the number of devices, read the QR code. Until the main program is launched, user interaction with the document management system and work with documents is impossible.

Program-server of ASA-CDRAT is performed on the computer connected to the network signaling and communications, which is also referred to as a server. It is possible to allocate a separate computer for the server or use one of the network workstations. It should be noted, however, that the registration of new equipment and the creation of the tasks and reports which are related to the instruments, lead to an increase in the size of the database and increase the disk space occupied by it, therefore, it is necessary to ensure sufficient capacity of hard disks, taking into account the prospects of growth of the information flow.

Administrative part of the program. A system which work many users with, should have centralized management [8-10]. This function is performed by a specially dedicated employee or employees who implement a single consistent policy

of configuration and management of the system, which are called administrators of systems.

The responsibilities of the system administrator include, in particular, the following:

- reflection of the current structure of the organization in the system;
- registration of users;
- view system messages and error messages;
- updating database tables.

In addition to these functions, the system administrator also provides the start and stop of the server ASA-CDRAT, configuration and maintenance of the system, creating backups of the system databases and restore the system in case of failures.

User part. Employees of the signaling distance and communication which registered in the system, determined by their official duties are called users of the system. Depending on the type of activity the system user is assigned by the administrator the rights to perform certain actions and access to certain functions.

By the users of the system can assign the following rights:

- Maintain the new section
- Maintain of new equipment
- Maintain information about repairing
- Maintain information about the inventory
- Print QR code
- Read QR code.

3. The conceptual model of the automated system of accounting for and control of devices of SCB

When introducing new equipment of users, included in one of the lists, by default, receive the appropriate rights - view or edit the document.

During registration to the documents added several semantic parts, which in turn occupy the corresponding places in various database tables.

The conceptual model and structure of data processing of the automated system of accounting and control of SCB devices are presented in Fig.1 and Fig.2.

The model consists of three levels. In the first level of management SH and distance SHCH has access authorization, equipment search, report on requests, user registration.

In the second level, the engineer of the RTA (CMP) has access to the maintenance of a new section, new equipment, information about the repair of devices, information about stocks, printing the QR code of the device and its scanning.

In the third level, the electrician of the SCB has access to authorization, equipment search, equipment replacement, report on requests, and reading the QR code.

User automated systems connected to the server software, which is directly connected to the database. The server software is, configured by the administrator. It also has access to the database, changing or adding a new user.

4. The choice of programming language

Creation of the project took place in the programming language "C#" in the environment "VisualStudio 2010", using NetFramework 4.0 version. The "C#" language is flexible and convenient, allowing you to create decent software products in the shortest possible time. The memory tools built into the language also facilitate the work of the programmer" [11]. But there are also disadvantages of this language, expressed in the slow operation of applications on weak computers.

The program consists of two main parts: user and server. The server connects to the database, and users, in turn, connect to this server to exchange information, receive and record data. The MSSQL system is chosen as the database.

The connecting users to the server is done via TCP/IP to avoid loss of important data. In addition, network technologies allow the use of high-speed communication channels for relatively small financial investments. The fall in prices for

telecommunications equipment is widely associated with scientific and technological progress.

In this scheme, the database and the server part of the electronic document management program can be located on the same server. This allows to reduce hardware requirements and reduce the load on the individual nodes of the network infrastructure.

The database consists of a number of necessary tables, such as the system users table (Users), the device table (Device), the instrument parameters table (Parameter), and other tables.

Each device is assigned several details during registration, allowing quickly finding them by searching in the database.

The system design. Since the system is a window option, during process has a transition from one window to another. The program also has a database in the form of a user-server.

The program-server performs several functions:

- processing user requests;
- output of necessary information;
- serves as an intermediary between the user and the database;
- carries out the user registration procedure.

Block diagram of the functioning of the automated system of accounting for and control of the SCB is shown in Fig.3.

Requests to the server program should be received via TCP/IP, as the data should not be lost along the way. As the data transmission software was decided to use a set of low-level Socket classesallowing to work with managed connections. Since there can be several users in this system (there should be no restrictions in the number of users; their number is limited by the networkbandwidth

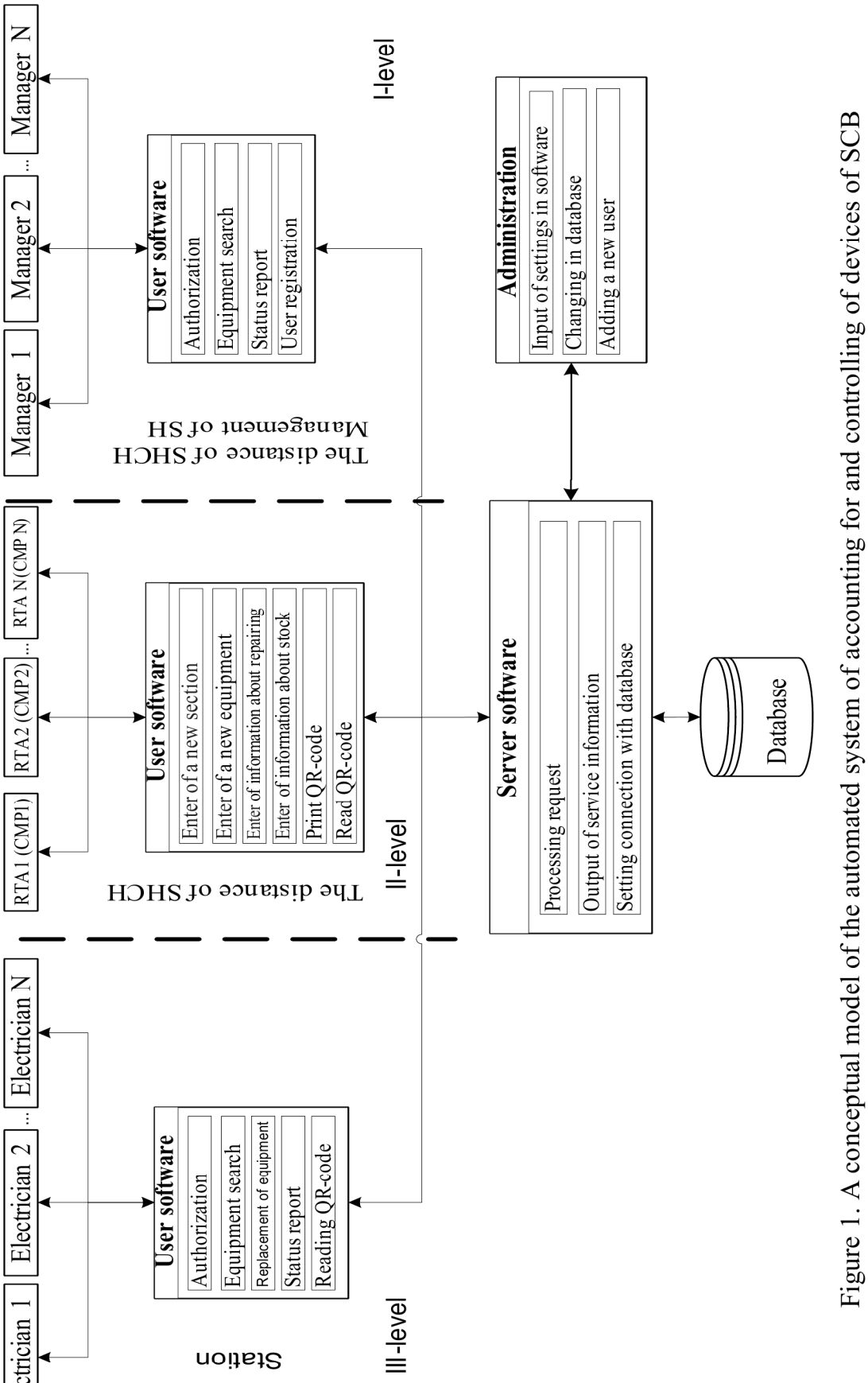

Figure 1. A conceptual model of the automated system of accounting for and controlling of devices of SCB

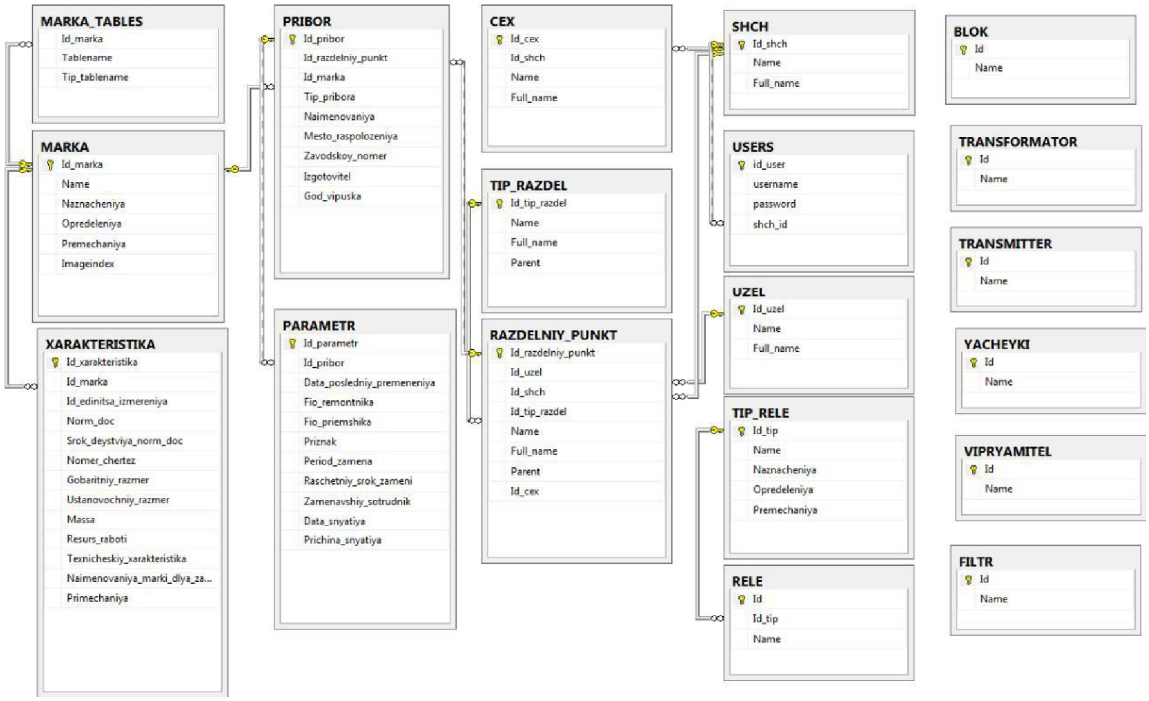

Figure2. The structure of the data processing of automated system of accounting for and controlling of devices SCB

and hardware performance), the program-server should work with them separately. Thus, it is planned to allocate users in independent streams which will be born at reception of a signal on new connection and to be closed at disconnection of the user. it is necessary to create several possible types of network requests that allow you to work in different modes of data transfer: sending, receiving, sending and receiving at the same time.

To comply with the principles of object-oriented programming is required to divide the code on semantic grounds in separate classes. Based on the functions performed by the program-server, there are three main classes:

- interface class for user interaction;
- class of network interaction with users;
- class with communicating the database.

All these classes are interrelated and serve to process user commands. First, the program is initialized, then the specified main classes are included. The network class

receives commands from the user, uses an auxiliary database interaction class to execute them, if necessary, sends a response to the user and reflects the results of its work on the user interface. Additional structural links can also be used. With this division into classes is realized encapsulation is a programming mechanism that combines data and code in one block, protecting them from external interference.

"Encapsulation allows you to combine data and code into an object and hide the implementation of the object from the user. In this case, the user is provided with only the specification (interface) of the object. The user can interact with the object only through this interface"[12].

To determine the status of the server and the correct execution of user requests, you must use the component to record service information in real time. This replenishing list, the so-called event log or log, should be located in the main window of the program-server in order to reflect the information for the system administrator in the most convenient way.

This should mainly include the results of database query processing, as this is a very vulnerable point in the system, especially if the program-server and the data warehouse are physically on different computers.

To reduce the number of additional programs into the server interface, it is necessary to embed the tool of the system user registration. The username (login or pseudonym), real name, surname and

ELECTRONIC JOURNAL OF ACTUAL PROBLEMS OF MODERN SCIENCE, EDUCATION AND TRAINING. JULY, 2019-II ISSN 2181-9750

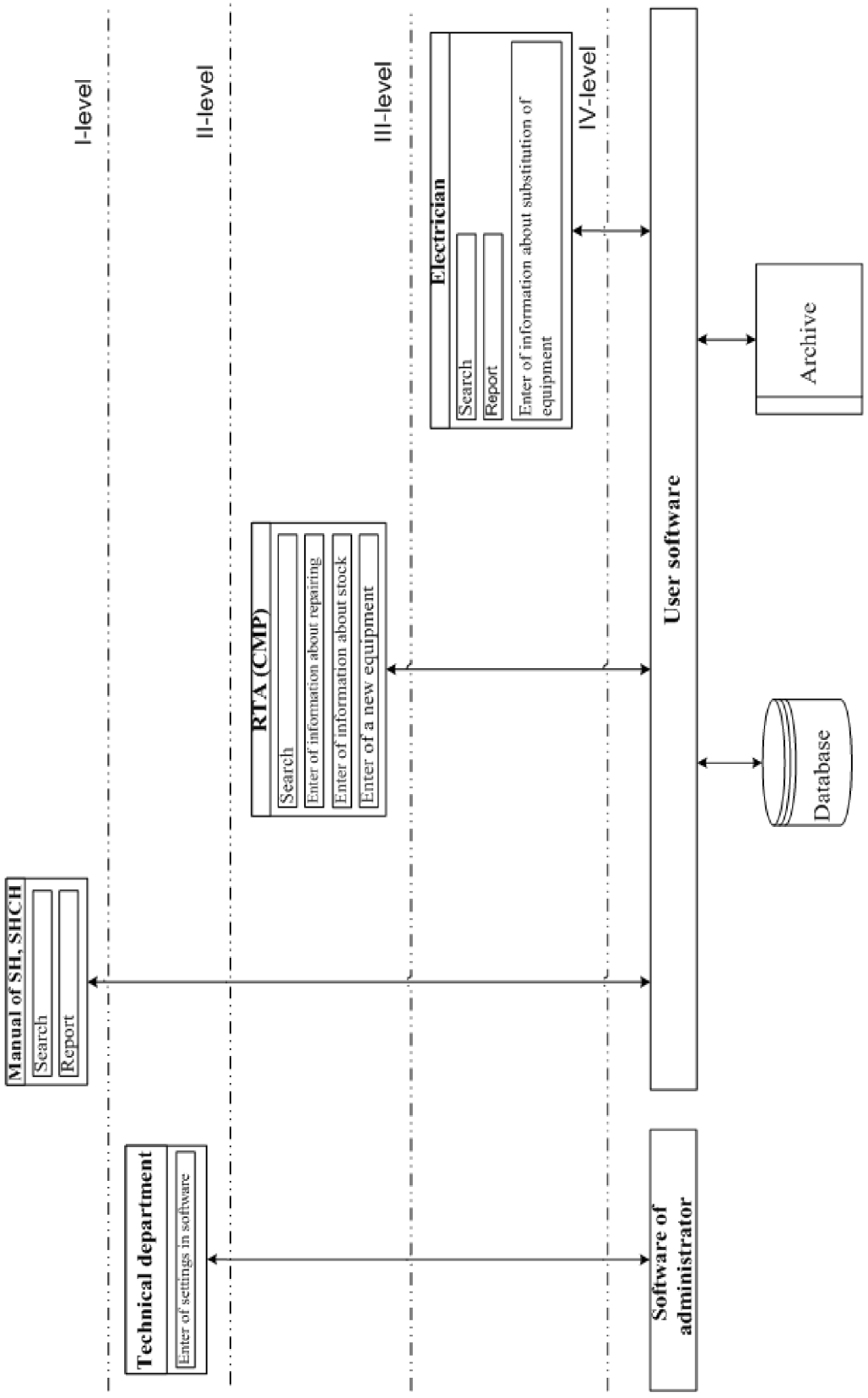

Fig 3. The scheme of functioning of the automated system of accounting for and controlling of devices SCB

patronymic, as well as password should be entered as the main identification data. It is also necessary to take into account additional user IDs in the organization: phone number, address and email. To increase system security, the password must be stored encrypted in the database.

The last but not the least important element in the server is the configuration parameters of the database connection and its starting deployment. To enable the server to use an arbitrary available host as a data source, it is necessary to enable the administrator to specify the connection parameters to the database server. The connection parameters include the IP address of the computer containing the database, the name of the database itself, the username and password of the user who has access to perform procedures for reading, writing and updating database tables. Also, a utility should be attached to the server for the initial creation of tables in the database and filling them with the necessary values.

This will allow without the help of third-party programs (perhaps even paid) and knowledge of the SQL language to prepare this system of document-flow for work.

Conclusions

Electronic document management on the basis of full functional support and development of electronic executive part of the system for control and accounting of railway automation and telemechanics devices in the form of ASA-CDRAT can significantly improve the efficiency of control and distances of signaling and communication, as well as enterprises associated with the processing of technical documentation.

In the article is given the description of the main components of the ASA-CDRAT. The structure of data processing, the conceptual model, the scheme of functioning, features of design of the developed automated system of the account and control are presented.

References:

1. Decree of the President of the Republic of Uzbekistan "On measures for

indigenous improvement of public administration system in the sphere of transport" dated February 1, 2019, No. UP-5647.

2. Bulavsky P.Ye. Conceptual model of electronic document flow of technical documentation / / Transport of the Russian Federation. – 2011. – №1(32).– p. 60-63.

3. Aripov N. M., Baratov D. H. Method of construction of mathematical model of electronic document flow of technical documentation of railway automation / / Automation in transport. - 2017. - Vol. 3. - no. 1.- p. 98-111.

4. Carson J. S. Model verification and validation / J. S. Carson // Proceedings of the 2002 Winter Simulation Conference, San Diego, CA, USA, December 08-11, 2002. Pp. 52-58.

5. Efanov D. V., Plekhanov P. A. Ensuring safety at the expense of technical diagnosing and monitoring of devices of railway automatics and telemechanics //Transport of Ural. - 2011. - no. 3. - P. 44-48.

6. Karim Kanso, Faron Moller, And Anton Setzer. Automated Verification of Signalling Principles in Railway Interlocking Systems // Electronic Notes in Theoretical Computer Science. #250 (2009). Pp. 19-31.

7. Baratov D. H., Aripov N. M. development of the system of accounting and control of electrotechnical complexes of railway automation and telemechanics //Fundamental and applied research: topical issues. - 2018. - P. 64.

8. Ibrahim Sener, Ozgur Turay Kaymakci, Ilker Ustoglu, Galip Cansever. Specification and formal verification of safety properties in a point automation system // Turkish Journal of Electrical Engineering & Computer Sciences. #24 (2016). 1384-1396.

9. Sokolov S. S., Belyaeva N. A. Functional structure of the automated control system of transport and warehouse infrastructure / / Bulletin of the state University of Maritime and river fleet. the Admiral Makarov. - 2012. - no. 3 (15).

10. Yurkov N. K. et al. Functional model of information technology to ensure the reliability of complex electronic systems taking into account external influences / / Proceedings of the international Symposium "Reliability and quality". - 2014. - Vol.1