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Functional Support of the Automated Accounting System and Control of Devices in Railway Automation Telemechanics

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ABSTRACT: The article discusses the issues of the functional support of the automated system of accounting and control of railway automation and remote control devices: signaling, centralization and blocking; components of the electronic-executive part of the system are presented; proposed a conceptual model and describes the design features of the developed automated system.

KEYWORDS: railway automation and remote control system, alarm devices, centralization and blocking, components of the electronic-executive part, conceptual model and design of an automated system of accounting and control devices.

I. INTRODUCTION

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

The use of various types of automated workstations, automated control systems, as well as elements of increased reliability, backup and duplication schemes in signaling, centralization and blocking devices (SCB) creates the prerequisites and is a condition for switching to the maintenance and repair technology for maintenance work: The use of repair [1-3] and restoration technologies for certain types of signaling equipment will allow: to increase the safety of train traffic and the efficiency of transportation management based on the high reliability of the serviced devices; to ensure the implementation of additional organizational and technical measures to improve train traffic safety by reducing the specific labor intensity of maintenance and increasing labor productivity [4-6].

Further automation of the control of device parameters using digital and analog signals will enable a switch to the restoration technology of servicing virtually all elements of the signaling equipment. At the same time, an important place will be given to the reservation and use of highly reliable elements with extended service life equal to or close to the service life of the electrical centralization systems, automatic locking, centralized control room, etc.

Currently, some of the technical means have developed a service life or are approaching this (in the signaling devices, this is about a quarter of the existing ones). In order to prevent further aging of the devices, the employees of the signaling and communication farm will have to significantly increase the pace of modernization of technical equipment in the coming years. At the same time, newly developed and developed domestic and foreign systems of electrical interlocking, automatic blocking, dispatching interlocking on a microprocessor basis should be introduced.
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 through technical progress, minimize the likelihood of the negative impact of the human factor on the process of ensuring trouble-free operation of technical equipment and, consequently, on the state of traffic safety of trains [7]. Considering that at present it is impossible to complete production with highly

Qualified and responsible executors, the task is to ensure the centralization of control over the condition of technical means and the correctness of performers.

Specialists of signaling and communication industry 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.

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To organize the accounting of railway automation and remote control devices, tracking their movement and operational identification, it is proposed to use an automated system for accounting and control of signaling devices.

II.DESCRIPTION OF THE AUTOMATED SYSTEM FOR ACCOUNTING AND CONTROL OF RSAT DEVICES.

Automated system of accounting and control of RSAT devices is intended for automation of accounting and control of railway automation and remote control devices, as well as for planning the operation of the repair and technological section (RTS) or control and measuring point.

Creation of ASO-CRAT aims to improve the quality and efficiency of work on the replacement and repair of signaling systems, the reasonableness of decision-making by experts and managers of the signaling and communication distance of the frequency response, signaling and communication departments АВТОМАТ and the laboratory of automation and telemechanics by automating the planning, optimization and control of performance of work.

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

- The creation and maintenance of a database that includes the passports of specific devices and information about the place of their installation;
- Tracking movements of devices in connection with periodic replacements, write-offs, receipts, etc.;
- Planning the replacement of devices with the issuance of technologically necessary information;
- Monitoring the implementation of replacement plans for devices;
- Failure device analysis of alarm devices, centralization and blocking;
- Planning of the repair and technological areas;
- Issuance of output documents, the ability to search for devices in the database for arbitrary requests.

The tasks and functions performed by the ASO-CRAT are listed in Table 1.

Tasks and functions performed by the ASO-CRAT

Functions	Content	Periodicity
1-task. Initial Devices Data Entry		
1.1. Data input	Initial input of data about devices with decompositions into stations, stages, locomotives, employees.	When installing
1.2. Formation of references	View and print online help on the placement of devices.	On request
2-task. Accounting and control of the movement of devices and their technological state		
2.1. Accounting for the arrival of new devices at a distance	Input of the data about the devices of the newly arrived at the distance into the database of the automated control system for automated control systems (RAST).	Upon the event
2.2. Accounting write-off devices	Input of data about the write-off of devices with the formation of documents for write-off (from the exchange fund of the RTS).	Upon the event
2.3. Accounting for the output of devices from repair	Recording data on the performance of work on the inspection and repair of devices, taking into account the fulfillment of planned tasks by employees of the RTS. Formation of data on the complaint in the case of verification of newly received devices.	Daily

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2.4. Accounting for scheduled instrument replacements	Fixation in the database of data on the movement of devices from the RTS to the line and back based on the information of the integrated replacement team or linear mechanics.	Upon the event
2.5. Failure replacement accounting	Fixation of operational information on device failures with the formation of data.	Upon the event
2.6. Accounting replenishment	Recording information on the movement of devices from the RTS to the stock.	Of necessity
2.7. Accounting conservation devices	Fixing the temporary withdrawal of devices from work and return them to the normal technological cycle.	Of necessity
2.8. Accounting for dismantling devices	Fixing the dismantling of devices and (or) their locations.	Of necessity
2.9. Accounting for the movement of devices between the exchange fund and the warehouse	Fixing the input of long-term storage devices into the replacement technology through the exchange fund and the reverse procedure.	Of necessity
3 task. Planning work areas of the RTS		
3.1 Formation of settlement plans	Formation of design plans for a month, year or an arbitrary period, taking into account the calendar dates of replacement or actually spent resources (based on simulation modeling).	According to the regulations and on request
3.2 Optimization of settlement plans	Formation of optimal replacement plans for devices.	According to the regulations and on request
3.3. Adjustment of settlement plans	Manual adjustment of replacement plans for devices.	According to the regulations and on request
3.4. Receiving output documents on settlement plans	Receipt of documents and their archives according to payment plans.	According to the regulations and on request
3.5. Formation of plans for the repair and verification of devices in the RTS	Formation of plans for the repair and verification of devices, taking into account the design plans, the completeness of the replacement, the availability of the staff of the RTS and the exchange fund	According to the regulations and on request
3.5.1. Optimization of plans for the repair and testing of devices	Formation of an optimal plan for the repair and testing of devices in the RTS, taking into account the technology of testing, qualification of employees, unscheduled work, etc.	According to the regulations and on request
3.5.2. Correction of plans for the repair and testing of devices	Manual adjustment of individual planning tasks for workers of the RTS for the repair and testing of instruments.	According to the regulations and on request
3.5.3. Receiving output documents for individual planning tasks	Receipt of documents from their archives according to individual planned tasks for the repair and verification of instruments.	According to the regulations and on request
4-task. Formation of regulatory documents and documents of arbitrary shape for users of the distance of signaling and communication of ShCh, signaling and communication departments of SH and laboratory of automation and telemechanics of SHL		

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4.1. Query formation	Formation of user requests for receiving data and receiving a response to ensure the exchange of data between databases of different levels of control (SH, SHCH, SHL).	Daily
4.2. Formation of documents of the established form	Balance sheet and its derivatives.	On request
4.3. Formation of documents of arbitrary shape.	Formation of documents and screen forms with a set of columns selected by the user on a set of data about devices stored in the automated control and management system for automated control and logging equipment at the road and remote levels.	On request
4.4. Formation of documents for failure analysis	Formation of technical conclusions analysis of failures.	Upon the event and on request
5-task. Service provision of the complex		
5.1 Maintaining and viewing reference books	Work with reference books: Types of devices, Workers of the RTS, Objects of a distance, composition of a stock, Polkamest and substitials in equipment, forced reloading of all directories.	On request
5.2 Software configuration, help	Editing user settings for working with the program. Show help program. Work with open windows in software. Provides the ability to view user access rights to software functions. Calls for automatic software version updates.	On request
5.3 Working with instrument duplicates	Provides functionality to identify duplicate devices in the database.	On request

For the functioning of the ASO-CRAT a personal computer with the following characteristics is necessary:

- IMB-compatible personal computer is not lower than the Pentium III 550;
- RAM/operative storage/ at least 128 MB;
- Free space on HDD/ hard disk / at least 30 MB;
- Local or network
-

III.COMPONENTS OF THE ELECTRONIC-EXECUTIVE PART OF THE SYSTEM

The operation of the automated control systems is based on the use of a special program - a document flow server. 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 a QR code. Until the main program is launched, user interaction with the document management system and working with documents is impossible.

The ASO-CRAT program server runs on a computer connected to the signaling and communication distance network, which is also called a server. For the server, it is possible to allocate a separate computer or use one of the network workstations. It should be noted, however, that the registration of new devices and the creation of instrument-related tasks and reports lead to an increase in the size of the database and an increase in the disk space it occupies; therefore, it is necessary to ensure sufficient capacity of hard disks taking into account the prospects for increasing the flow of information.

The administrative part of the program. A system with which many users work must have centralized management [8-10]. This function is performed by a dedicated employee or employees who implement a single consistent policy for setting up and managing the system, which are called system administrators.

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

- reflection in the current structure of the organization;
- user registration;
- view system messages and error messages;

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- updating database tables;

In addition to these functions, the system administrator also provides for starting and stopping the ASO-CRAT server, setting up and maintaining the system, creating backup copies of the system databases and restoring the system to work in case of failures.

User part The employees of the signaling and communication distance 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 right to perform certain actions and access certain functions.

System users can be assigned the following rights:

- Maintain a new section
- Maintain a new equipment
- Maintaining repair information
- Maintain stock information
- Print QR code
- Reading a QR code

IV.CONCEPTUAL MODEL OF THE AUTOMATED SYSTEM OF ACCOUNTING AND CONTROL OF SIGNALING SYSTEMS.

When new equipment is introduced, users included in one of the lists, by default, receive the corresponding rights - to view or edit the document.

When registering, several semantic parts are added during registration, which, in turn, occupy the corresponding places in various database tables.

The conceptual model and structure of data processing of the automated system for accounting and control of signaling systems are presented in Figure 1 and Figure 2.

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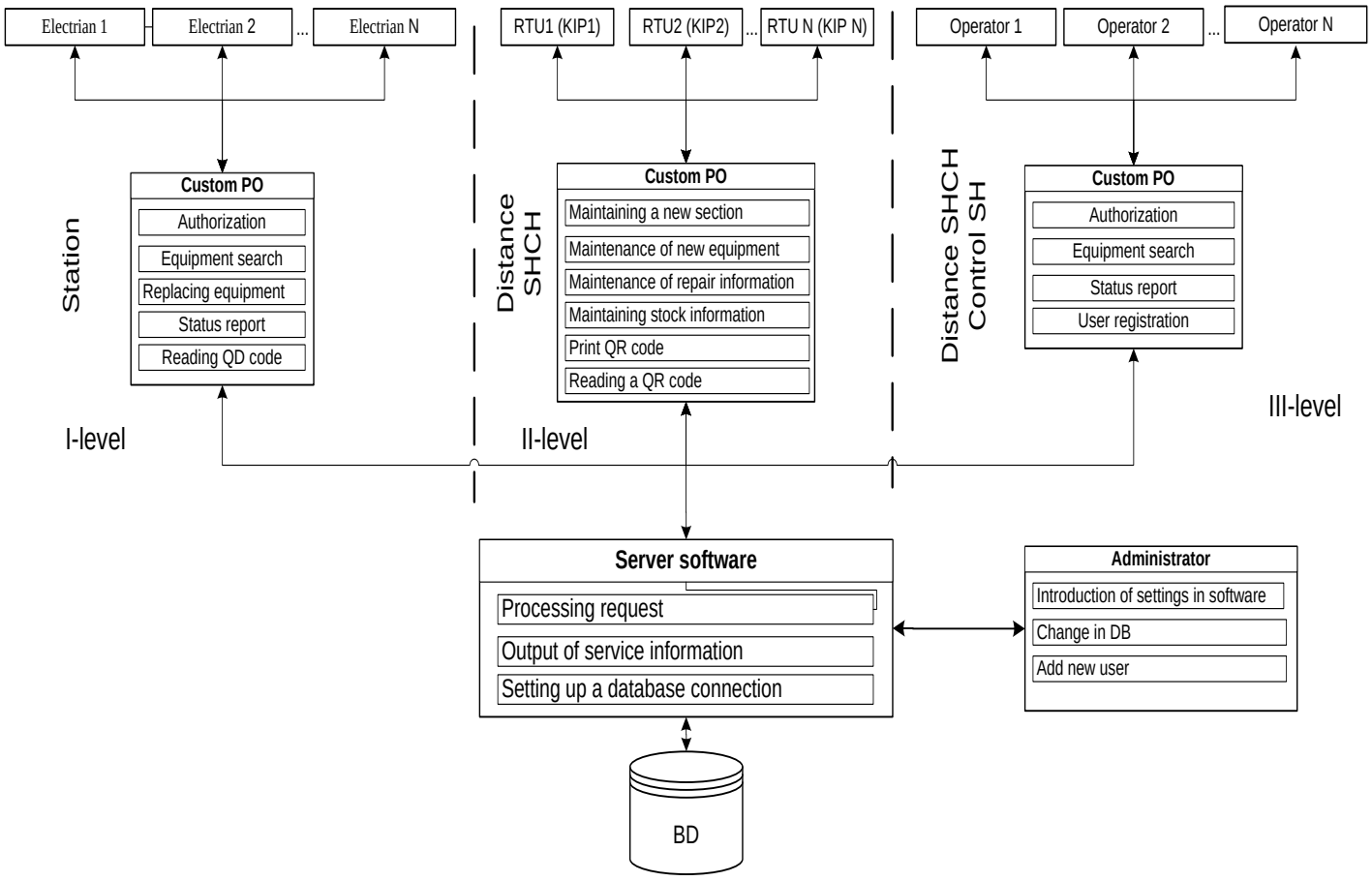

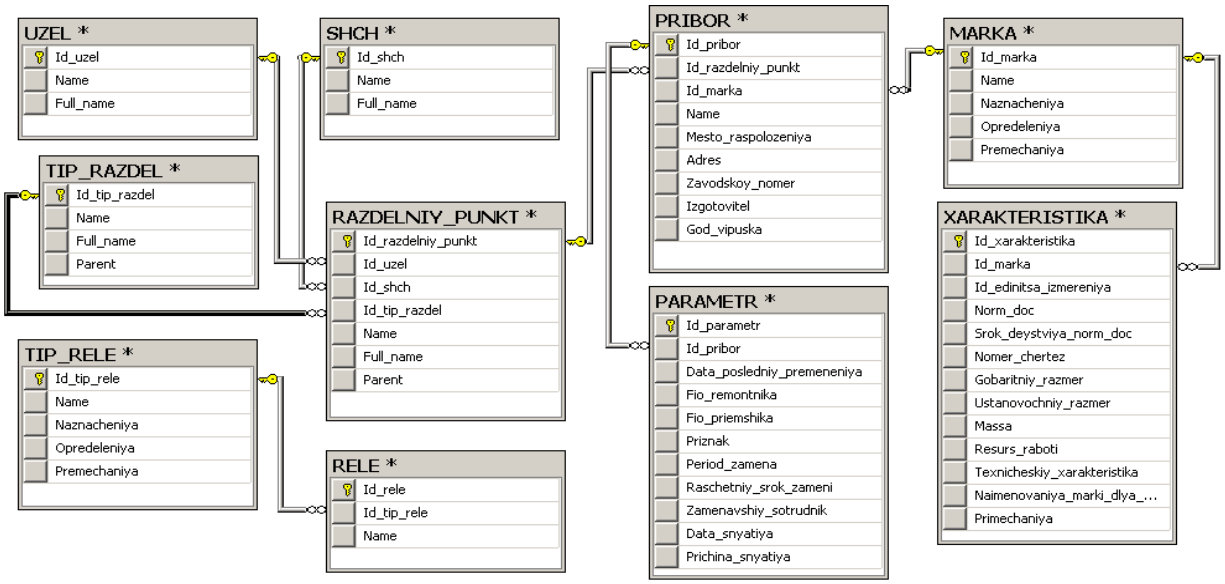

Fig.2. The structure of the data processing of the automated system of accounting and control of signaling systems.

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V.SELECT PROGRAMMING LANGUAGE

The project was created in the C # programming language in the VisualStudio 2010 environment using the NetFramework 4.0 version. The C # language is flexible and convenient, allowing you to create decent software products as soon as possible. The memory tools built into the language also facilitate the work of the programmer "[11]. But there are also drawbacks to this language, which are expressed in the slow-motion 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 write data. The MSSQL system is selected as the database.

The users are connected to the server via TCP / IP to avoid the 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 universally associated with scientific and technological progress.

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

The database consists of a number of necessary tables, such as a table of system users (Users), a table of devices (Pribor), a table of instrument parameters (Parametr) and other tables.

Each device at registration is assigned several details, allowing you to quickly find them by searching in the database.

A. SYSTEM DESIGN

Since the system is a windowed version, during the operation of which there is a transition from one window to another. The program also has a database in the form of user server

The server program performs several functions:

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

The block diagram of the functioning of the automated system of accounting and control of signaling systems is shown in Fig.3.

Requests to the server program must come through TCP / IP protocol, since data should not be lost along the way. As software data transfer, it was decided to use a set of low-level Socket classes that allow working with managed connections. Since there may be several users in this system (there should not be software restrictions on the number of users; their number is limited by the network bandwidth and equipment performance), the server program should work with them separately. Thus, it is planned to allocate the users into independent streams, which will be generated when a signal about a new connection is received and closed when the user disconnects. You need to create several possible types of network requests that allow you to work in different data transfer modes: sending, receiving, sending and receiving at the same time.

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

- interface class for user interaction;
- network user interaction class;
- database connection class.

All these classes are interrelated and serve to process user commands. First, the program itself is initialized, then the specified main classes are included. The network class receives commands from the user, uses an auxiliary class of interaction with the database 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 may also be used. With the help of such a division into classes, encapsulation is implemented - it is a programming mechanism that combines data and code in one block, preventing them from outside interference and improper use. "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 only provided with the specification (interface) of the object. The user can interact with the object only through this interface "[38].

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To determine the state of the server and the accuracy of user requests, it is necessary to use the component to record service information in real time. This update list, the so-called event log or log, should be located in the main window of the server program in order to most conveniently reflect information for the system administrator. This should mainly include the results of processing requests to the database, since this is a very vulnerable point in the system, especially if the server program and data storage are physically on different computers.

To reduce the number of additional programs, it is necessary to build in the system of users registration in the server interface. The main identification data must include the user name (login or pseudonym), real name, surname and patronymic, as well as a password. It is also necessary to take into account additional identifiers of the user in the organization: telephone number, address of location and e-mail. To increase the security level of the system, the password must be stored in an encrypted database.

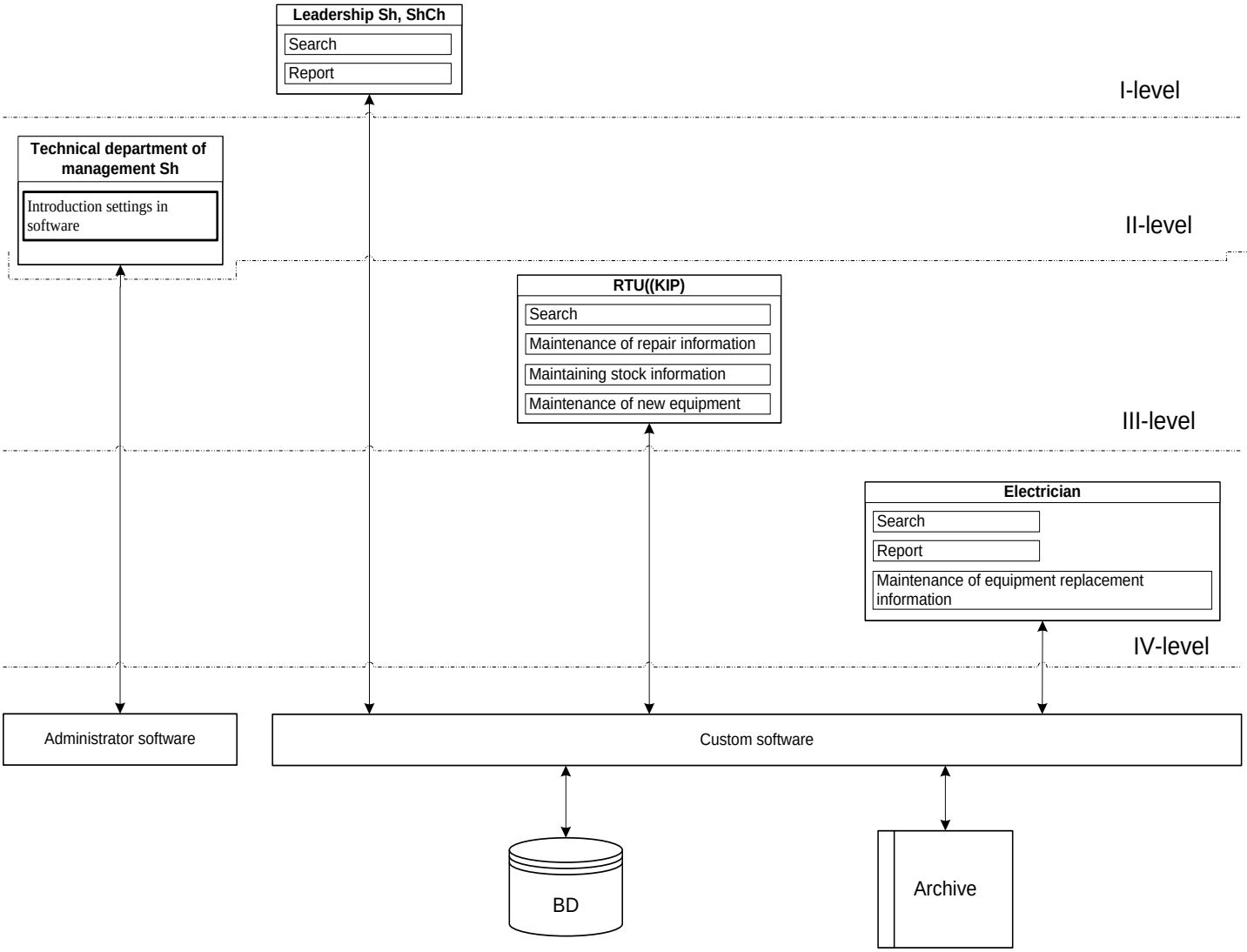

Fig.3. The scheme of functioning of the automated system of accounting and control of signaling device

The last but not least important element in the server is the configuration parameters for connecting to the database and its initial deployment. In order for the server to use an arbitrary available network node as a data source, you must enable the administrator to set the parameters for connecting to the database server [12]. The connection parameters include the IP address of the computer containing the database, the name of the database itself, the login and password of the user who has access to perform reading, writing and updating of the database tables. Also, the utility should be attached to the server for the initial creation of tables in the database and filling them with the

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

VI. CONCLUSION

Electronic document management on the basis of full functional support and development of the electronic-executive part of the system for monitoring and recording railway automation and telemechanics devices in the form of automated control systems allows the management and distance of signaling and communication, as well as enterprises involved in the processing of technical documentation to be significantly increased.

The article describes the main components of the ASO-CRAT. The structure of data processing, the conceptual model, the scheme of functioning, the design features of the developed automated accounting and control system are presented.

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