Optimization Of Digital Monitoring And Automation Technologies For Railway Automation And Telemechanics Devices

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Abstract
The article outlines the process for developing an electronic document management system for technical documentation (EDTD), explains its generalized formalized scheme, introduces a formal model of EDTD, automates the organization's document passing process, and offers the following features: These fundamental ideas form the foundation of the organization. The system improves transparency and accountability in managing railway automation and telemechanics documentation. It also enables real-time monitoring and secure data storage through a centralized server platform.
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Introduction.

The following features are offered by the automated accounting and signaling device control system, which is intended to automate document passing procedures inside an organization:
- registering documents;
- distribution of electronic documents among staff members;
- authority over document transmission and accompanying order execution;
- generating logs and reports;
- electronic message transmission amongst staff members.

The system is multi-user and allows a team of employees to work together in a coordinated manner. Both the system's structure and the requirements for its configuration — such as identifying system users, controlling access rights to processed data, and guaranteeing the security and integrity of data—are to blame for this.

The system must be used within the organization's local network and features a client-server architecture. With this kind of system architecture, you can offer the following essential features:

- the arrangement of an arbitrary, readily adjustable number of occupations, as dictated by the amount of labor, the type of tasks completed inside the business, and the number of employees needed for this;
- efficient safeguarding of data integrity when using the multi-user access method;
- guaranteeing information security because of its centralized recovery and archiving;
- maintaining information confidentiality through the control of access permissions.

The following fundamental ideas serve as the foundation for document accounting and tracking of their movement within the company:
- the process by which a person with the authority to modify documents — a registrar — creates a new document in the system is known as document registration;
- registration form of a document: a collection of characteristics that identify important details about the document so that you can locate it in the database and follow its progress;
- task associated with carrying out a document that the organization's management has given to an employee;

- execution of a document — a series of steps taken by a professional (the responsible executor) or a team of professionals (co-executors) carrying out directives for processing a document and then passing it on to other executors afterwards;

- document execution control, which is carried out by a user who has been specifically designated as the controller, tracks the document's actual passage and the time at which it is executed inside the company [1-3].

The electronic executive system's constituent parts

Software for servers. The employment of a unique program called the document management server is essential to the operation of the document management system. The primary tasks that guarantee users' work are performed by the document management server: receiving requests, accessing the database, processing data, and providing results. Users cannot work with papers or communicate with the document management system until the main software is activated.

The workflow server software itself operates on a server, which is a computer that is part of the organization's network. Depending on the volume of document work, either a network workstation or a separate computer might be chosen for the workflow server. We can predict that a document flow server running on a middle-class workstation is perfectly fine for minor document flows (up to 100 per day), and that it can be used concurrently for regular office tasks without experiencing a significant slowdown. However, it should be noted that the creation of document-related jobs and messages, as well as the registration of new documents, result in an increase in the size of the database and the amount of disk space it takes up. For this reason, one must make sure that there is enough hard disk capacity to accommodate the possibility of an increase in the flow of documents [5].

Program's administrative component. It makes sense to centrally manage a system that is used by numerous people. System administrators are a specially appointed individual or employees who carry out this role by implementing a single consistent policy for setting up and maintaining the system.

Specifically, the following are among the responsibilities of the system administrator:
- consideration of the organization's current structure in its system;
- enrollment of users;
- going through error and system notifications;
- making changes to the database tables.

Along with these duties, the system administrator also handles workflow server startup and shutdown, system configuration and maintenance, database backup creation, and system restoration in the event of an outage [6-9].

Client-side. A system user is an employee of an organization who has registered and is using the system to process documents based on their work duties. According to the nature of the activity, the administrator grants the system user the authority to carry out specific tasks and view specific documents. System users may have different access levels depending on their roles, such as read-only, editing, or administrative rights. The system logs all user actions to ensure traceability and accountability. User authentication is performed through a secure login process, ensuring that only authorized personnel can access sensitive data. Users can also receive automated notifications about task deadlines, document updates, or approval statuses.

Users of the system may be granted the following privileges:
- authority to carry out directives and responsibilities. A user with these rights can act as a controller and keep an eye on how papers and employee directions are being carried out;
- management of the system. Such rights allow a user to carry out the duties of a

system administrator, including creating user accounts, granting users rights, and altering system configurations;

- the level of access to each of the available document streams can also be granted to the user by adding the following to the relevant list:

- a list of people who have the ability to register new documents in this stream is known as document editing.

Figures 1 and 2 illustrate the automated system model for enrolling and controlling signaling devices as well as the data processing structure.
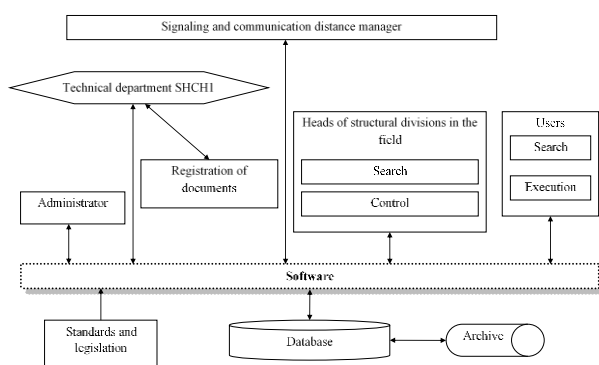

Figure 1. Conceptual model of the automated accounting and signaling device control system.

Creating a Server Program

A number of tasks are carried out by the workflow server program:

- handling client demands;
- production of logs including service information;
- acts as a go-between for the client and the database;
- completes the process of registering a user.

The automated accounting and control system of signaling devices' structure diagram is displayed in figure 3.
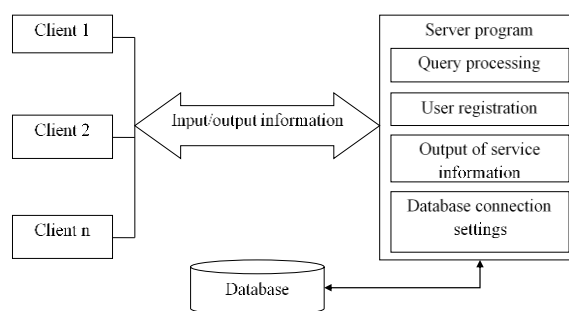

Figure 2. The automated accounting and signaling device control system's operational scheme

Since data should not be lost in transit, requests to the server software should be sent using the TCP/IP protocol. A collection of low-level NetSockets classes was chosen as the software data transfer method, enabling the use of managed connections. The server program must interact with each client independently because a system may have multiple clients (the number of clients should not be restricted by software; rather, it is determined by hardware performance and network bandwidth). It is therefore intended to divide clients into separate threads, which will be created upon receiving a signal indicating a new connection and terminated upon the user's disconnection. Several sorts of network requests must be created in order to interact with various data transmission modes, including sending, receiving, and sending and receiving at the same time.

Semantic characteristics must be used to segregate the code into distinct classes in order to adhere to object-oriented programming standards. Three primary classes can be identified by the tasks that the server program completes:

- an interface class for user interaction;
- class of client interactions on a network;
- classification of the database connection.

These classes all work together to process commands from clients. The program is initialized first, followed by the inclusion of the designated major classes. After

receiving commands from the client, the network class executes them using a helper class to communicate with the database, responds to the client if required, and displays the output of its work on the user interface. You can also use other structural linkages. Encapsulation, a programming technique that unifies data and code into a single block to shield them from outside influence and misuse, is implemented with the aid of this class division.

Data and code can be combined into an object by encapsulation, which also conceals the object's implementation from the user. In this instance, the user is merely shown the object's specification (interface). This interface is the only way for the user to interact with the item.

The real-time service information recording component must be used to ascertain the server's condition and the accuracy of client request execution. It is recommended that the server program's main window display this updated list, also known as the event log or log, so that the system administrator can access it at their convenience. This should primarily contain the outcomes of database query processing, as this is a highly vulnerable area of the system, particularly if the server software and data storage are physically located on separate systems.

The server interface must include a system user registration tool to reduce the need for additional applications. Entering the username (login or alias), real name, surname, patronymic, and password is the primary means of identification. Other user identifiers within the company, such as phone number, physical address, and email, must also be considered. The password needs to be kept in an encrypted format in the database to raise the system's security level.

The server's setup parameters for the database connection and first deployment are the final but equally important

component. The administrator must be able to configure parameters for connecting to the database server so that the server can use any available host as a data source. The IP address of the computer hosting the database, the database's name, and the login credentials of a user with read, write, and update capabilities are all included in the connection parameters. Additionally, in order to create tables in the database and populate them with the required values, a utility needs to be linked to the server. This will enable you to have this document flow system ready for use without the need for third-party software — possibly even ones that are paid for — and without needing to know SQL.

The research presented the structure and functionality of an automated accounting and control system developed for digitizing and managing document flow. The system performs key functions such as document registration, distribution among employees, task execution monitoring, report generation, and internal electronic communication. Based on a client-server architecture, it enables synchronized multi-user collaboration. The server application handles client requests, interacts with the database, and returns results to the client interface. Key features include ensuring data integrity, managing user permissions, and maintaining real-time operation logs. The system also supports user registration, configuration management, and backup operations. The software architecture follows object-oriented programming principles, using modular class separation to enhance scalability and maintainability. By integrating administrative and operational functionalities into a unified platform, the system ensures secure, efficient, and structured document management. This approach improves organizational transparency, reduces the risk of data loss, and eliminates reliance on third-party tools or manual processing,

enabling reliable implementation in technical and industrial domains.

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