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ІТ-ПРОСТІР СЬОГОДЕННЯ: ТЕНДЕНЦІЇ, ІННОВАЦІЇ ТА ПЕРСПЕКТИВИ РОЗВИТКУ

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MINISTRY OF EDUCATION AND SCIENCE
OF UKRAINE
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**IT-SPACE OF TODAY:
TRENDS, INNOVATIONS
AND DEVELOPMENT PROSPECTS**

Collection of abstracts
of the II International Scientific and Practical
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DEVELOPMENT OF A WEB APPLICATION FOR TRACKING POSTAL TRANSPORTATION

The purpose of the work is to develop and implement an interactive software package of simulation modeling "Postal Sandbox" for optimization, tracking and operational management of inter-hub transit of goods based on the digital logistics graph of roads in Ukraine. The object of the study is the processes of internode trunk transportation, consolidation and sorting of cargo flows in distribution logistics networks. The subject of the study is architectural patterns, asynchronous software tools, relational data models and mathematical optimization algorithms on graphs used to build interactive web simulation modeling systems. Research and development methods – structural and functional analysis of systems (IDEF0), RUP requirements management methodology, graph and priority queue theory (Dijkstra algorithm), relational data modeling (3NF), asynchronous web programming, containerization and continuous integration methodology (CI/CD).

The current stage of development of the global and national economy is characterized by a rapid growth in the volume of postal and logistics transportation and the complication of the structure of distribution networks.

The effective functioning of logistics operators directly depends on the efficiency of dispatching decisions, optimization of rolling stock routes and minimization of costs for sorting cargo flows in intermediate hubs.

However, the design and management of such systems is associated with high risks due to the dynamism of processes, the randomness of the influx of orders, and the presence of severe physical limitations (fleet carrying capacity, warehouse throughput, etc.).

Under these conditions, classical analytical methods of calculations become ineffective, which determines the high relevance of the use of simulation modeling methods.

Simulation modeling allows you to create a secure digitized sandbox environment to reproduce real processes, stress test the infrastructure and analyze the behavior of the network under load without real financial costs.

An additional factor of relevance is the need to create specialized interactive simulators for the training of future specialists in the field of software engineering and logistics management.

The development of lightweight, cross-platform, and decentralized web complexes (SPAs) with reactive visualization of geospatial data is a sought-after

engineering task that requires the integration of a modern asynchronous technology stack.

Determining the content of the subject area forms the necessary context through which an understanding of the set of tasks is created, the solution of which is devoted to this diploma project.

The specificity of the study lies at the intersection of simulation modeling of objects, digitalization and optimization of processes for managing transport and warehouse networks of postal operators.

The main goals of developing logistics systems in the modern market are to minimize time and financial costs for transporting goods while ensuring maximum reliability.

To achieve these goals, the developed system should solve the tasks of monitoring and dispatching network resources (vehicles and queues of parcels in warehouses) in real time, have the functionality of optimizing routes between network nodes and provide simulation testing capabilities in a risk-free environment.

The context of the subject area is determined by the boundaries of the postal network of Ukraine, which operates on the network-hub principle.

This includes processes related to the registration of shipments, the accumulation of cargo in regional warehouses, the selection of parcels relative to the vehicle capacity limit, as well as the direct execution of flights.

The scope of application of the developed software product can be transport and logistics companies and postal operators, where the product can be used as an analytical planning tool to assess the efficiency of hubs and optimize cargo handling processes, or educational institutions, where the product can be used as a simulation bench to study the behavior of complex dynamic systems and optimization algorithms.

The subject area under study has connections with such other subject areas as graph theory, discrete mathematics, simulation modeling and operations management.

The key concepts and terms of the subject area are:

Department/Department/Node is an object of logistics infrastructure that has geographical coordinates, performs the functions of cargo accumulation and acts as the start, transit or end point of the route.

Parcel/Cargo is a discrete unit of accounting characterized by a unique identifier, destination, life cycle status, and abstract mass parameter.

Vehicle/Fleet is a mobile unit of the system that has a fixed limit of maximum carrying capacity and moves the declared volume of cargo between the nodes of the graph.

A trip is the process of moving a vehicle along the calculated shortest chain of adjacent edges of the graph, containing dynamic parameters of the total distance and the remaining path.

Transit unloading is a logistical operation of unloading parcels at a node that is not the end point of the vehicle's current trip, but is a destination for a specific parcel, allowing consolidated delivery schemes to be implemented.

Logistics systems are undergoing significant evolution under the influence of technological progress and changes in the architecture of business processes.

Planning has changed from static to dynamic, because previously routes were formed once a day according to rigid schemes, and modern systems require prompt restructuring of delivery plans in response to the current workload of warehouses.

In addition, the growth of e-commerce has led to an exponential increase in the density of parcel flow, which requires testing of logistics systems under load using simulation algorithms for random generation of dense flows of orders.

The evolution of communication means requires software to instantly synchronize the state of the system and visualize the movements of objects, which is implemented in the system through regular reactive data pooling by the client part. In addition, the growth of e-commerce has led to an exponential increase in the density of parcel flow, which requires testing of logistics systems under load using simulation algorithms for random generation of dense flows of orders.

To organize collaboration and source code versioning in the GitHub SCM system, a lightweight, agile GitHub Flow strategy was chosen. This strategy involves the presence of one stable main branch and the creation of short-lived functional branches for each engineering task.

During the deployment of the logistics sandbox simulator, a comparative analysis was carried out between on-premise and cloud infrastructures. Given that the Postal Sandbox is being developed as an on-premises training and simulation prototype that does not require global scaling to millions of users, the cloud model (IaaS/PaaS) is financially and architecturally redundant. It was decided to use local infrastructure (On-Premise) based on the technology of containerization of applications (Containers-as-a-Service, CaaS – Docker).

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Електронне наукове видання
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Можна використовувати в локальному та мережному режимах

ІТ-ПРОСТІР СЬОГОДЕННЯ: ТЕНДЕНЦІЇ,
ІННОВАЦІЇ ТА ПЕРСПЕКТИВИ РОЗВИТКУ

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