DEVELOPMENT OF INTELLIGENT INFORMATION AND CONTROL TECHNOLOGIES FOR EFFICIENCY UPGRADING OF VEHICLE APPLICATION

Introduction. One of the major problems in the transport complex is creation of conditions for highly efficient application of vehicles with the observation of requirements of reliability, no-failure operation, robustness, fuel efficiency, application safety, environment, ergonomics etc. Because of this the development of technologies which are aimed at this problem solving is by far urgent. The practice of creating modern automotive instruments and devices, units and systems was ahead of the theory of the information analysis and synthesis of complicated systems. Existing separate solutions by information support of transport call for generalization, standardization and unification, definition of new special requirements on the creation of computer systems and networks in transport.

Materials and methods. In connection with the constant information social development and its industrial component, new transport systems and machines have achieved much success in sophistication of highly informative level. Thus, the new contradiction between swift development of informatization means and methods of complicated objects and systems and heterogeneous nature of the existing subsystems and links of the transport complex has evolved. Elimination of this contradiction makes possible conditions for highly efficient application of vehicles at all levels of the transport infrastructure.

Laws and practice of information technologies application became the basis of intellectualization of transport machinery and systems and it was embodied in researches by telematics, mechatronics and synergetics [1-4]. However, in their researches it was not embodied such problem solution of contemporaneity as solution of contradictions between achieving a high level of the society informatization and swift development of the transport telematics and the existing state of heterogeneous computing resources on transport.

The creation of the unified information space of transportation carriers is presented possibilities for the execution of computations which were previously accessible only for supercomputer solutions at the expense of distribution of computational processes between computer resources of movement participants. This will allow to receive to road user (transportation carriers) the economic analogue of the powerful system and give conditions for creation of a new service of computing resources allocation to order.

The aim of the research is development and introduction of web-based technologies for upgrading of vehicle application efficiency as well as for the whole transport complex as a whole. The internet technologies are to provide the synergetic integration of computing resources of all road traffic participants – from a separate vehicle to the corporative level of the transportation carrier. These technologies are designed for monitoring both a separate vehicle and the transport city system or a region as a whole and they are to locate a vehicle, to determine movement environment state and to provide road users (vehicle drivers, transportation carriers) by data about a vehicle state and a transport system as a whole.

Results and discussion. The developed web-based technologies provide data recording, processing and their presentation to all traffic participants in the real-time mode both for operational decision-making by the analysis of traffic situations and for data accumulation. Information functions of problem solving of continuous monitoring of the transport network are beneficial for reducing costs to the improvement of the existing transport systems.

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Thus, the quality of decision making on transport service management of large cities and regions is improved.

Created web-based technologies are based on the following principles [2-4]:
- the active integration of vehicle information resources of traffic users and transportation carriers of local, regional and national levels;
- creation of the distributed control system of the transport complex;
- the synergetic self-organization of subsystems and transport complex links;
- the application of X-by-wire and Wireless technologies;
- mechatronization of vehicles and their systems.

These organization principles of transport systems have a certain analogy with the society informatization and they can be realized on the basis of unified information space creation in transport. As the physical realization of such space the distributed system of computing resources of the transport internet portal makes itself evident. The source of information for this portal is the distributed network of information and communication systems installed on board of vehicles.

Software and hardware of internet technologies (information and communication complex) enables to conduct:
- monitoring of vehicle technical state and the psychophysical state of a driver;
- video observation of the traffic environment state of transport systems;
- environmental monitoring (air pollution registration);
- pavement state assessment (evenness and road-holding capacity);
- data binding about the automobile road state to a certain point of the street-road network route in view of vehicle speed variation at the time of measurements;
- process control of measurements and viewing retrospective information;
- electronic database formation for traffic environment state monitoring;
- processing the measurement results and data accumulation about the transport system state.

The input data for the information and communication complex are indices of the whole number of vehicle transducers its current coordinates in space and speed. These data are processed and from them the packet is formed which is transferred to the transport portal using wireless communication facilities.

Data are transferred and stored in the clear text format (ASCII). However the data packet itself is formed in accordance with accepted TCP/IP protocols of the internet. Additional information in the system is video data about the traffic environment state. This information requires higher capacity of communication channels. The initial data of the system is a specific location of vehicles (equipped by the information and communication complex) and it is well represented in the transport portal adjacent to parameters of their traffic. The transport portal user gets access to cartographic data, textual and graphical information about the state of transport routes. The information and communication complex is a system which is built into a transportation facility. The location of the equipment on the vehicle board is determined in accordance with a make of a vehicle and the availability of issued places for positioning of the electronic equipment and the complete set of the complex-borne itself (for example, in an issued place of 1-DIN (180x50mm) the auto radio-tape recorder siting). In the case of the absence of an issued place of equipment mounting of the information and communication complex it should be determined a set of measures as to vehicle field changes (for example, additional equipment in a special laboratory of the Kharkov national automobile and highway university). The onboard system is modular and, when the occasion requires it has the technical potentialities to increase channels of data record.
The structural board system consists of the following modules:
- the microcontroller system of data record about dynamic traffic characteristics and a vehicle state with the network interface module;
- GPS-signal receiver;
- the video observation module and the communication equipment.
All systems have off-line storages, which in the case of communication loss between the communication module and the web portal will allow to restore data which has been recorded.

For communication with the transport portal technologies on the basis of the cellular radio: 3G at the rate of data transfer in the region of 144 kbit/s or more and 4G (WiMAX) at the rate of data transfer no more than 40 Mbit/s.

Internet technologies are based at the two-level automotive information and communication system which contains the information and communication complex built into a vehicle and the transport portal in the internet information environment. The integral part of internet technologies is a distributed system of user support by data about the state of vehicles and the system as a whole.

Requirements to no-failure operation indices of the information and communication complex are set for separate functions:
- mean-time-to-first-failure of the information and communication complex in the operation with normal conditions is no less than 100 000 hours;
- mean-time of serviceable condition restoration of the information and communication complex by unit replacing or the device module is no more than 1 hour with regard to trouble shooting time;
- service life of hardware components of the information and communication complex is no less than 3 years;
- no-failure operation at the development stage is supported analytical (calculation) method with the exponential law of failure rate distribution in the process of operation by the calculation of operational reliability on the basis of serviceability monitoring;
- maintainability at this point of development is confirmed by the calculation method on data derived from the expert estimation of reconditioning time at the process of operation by value calculation of the maintainability index based on its observation.

Mounting, operation and repairs to hardware components of the information and communication complex must be performed taking into account the requirements described in their service forms and records.

For information protection of developed technologies provision is made for:
- the system of passwords for the personnel which provides the authorized access to information arrays;
- the information which is stored and transferred is protected from loss in case of emergency when the power supply is turned off.

Software requirements. The software is sufficient to implement all functions of the information and communication complex as well as it provides a possibility to replace and to add its software modules in order to modify and to build up the functional potentialities.

To test chosen technical solutions and to finish the functional system algorithm and verification of the accuracy of measurements a prototype of the information and communication complex has been developed and the setting-up procedure of the operating version of the transport portal has been carried out. The transport internet portal provides traffic users by navigation problem solving, vehicle and network state estimation and recommendations for
their improvement.

The transport internet portal has been developed with application of the general system software (table 1) and it is being operated using it now.

The transport web portal takes account limitations of the available tools of wireless communication systems, that is the channel capacity from 100 Kbit/s to 10 Mbit, as well as coverage limitations and possible communication disconnections. The architecture of the portal platform accounts for the existing decisions of the IT infrastructure of the transport carriers, for example, the availability of Proxy-server.

Table 1

<table>
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<tr>
<th>Purpose</th>
<th>Characteristics</th>
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<tr>
<td>1. Portal platform</td>
<td>Linux and Windows server systems using virtualization technology</td>
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<td>2. Server of applications</td>
<td>Apache and IIS with PHP support</td>
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<tr>
<td>3. Content saving facilities</td>
<td>The combination of control systems by website content on the basis of PHP. Joomla – the basic portal. WordPress – the blog of users. Moodle – user training and polls</td>
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<td>4. Specific problem solving</td>
<td>The development of client-server applications, for the most part in PHP</td>
</tr>
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<td>5. Database control system</td>
<td>My SQL, PostgreSQL and SQL Server</td>
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<tr>
<td>6. Information protection support facilities</td>
<td>The application of encryption technologies, protection from unauthorized interference through a password system</td>
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The transport and web portal contains the completed set web 2.0 services in the unified component architecture. Services have both server components and complete graphic interface components for the final user implemented in the same style. The server of the transport portal is consistent with requirements of the necessity and sufficiency to perform corresponding tasks with regard to the increase of computation bodies as the information flow enhancement.

The web-portal interface has a possibility to represent cartographical data, information in the form of tables and graphical data as well as takes into account current tendencies for data presentation and it is intuitive and intelligible for users.

Working places of final users of the system should be built mostly on existing computing facilities of transportation carriers.

Conclusions. As a result of the work the prototype of the information and communication complex has been produced; the operating version of the transport portal on the server has been created; the prototype software of the onboard information and communication complex and transport portal modules has been developed; software, hardware and technical solutions of interactions of the onboard information and communication complex with the transport portal have been devised; network interfaces and protocols of data transfer have been determined; data processing procedure has been developed; the prototype tests of the onboard information and communication complex have been carried out; the analysis of the channel capacity and recording data facilities has been performed; technical tools to achieve
scalability and adaptation of the internet technology to increase a number of users have been determined; procedures of web-technology introduction have been devised; the introduction of web-technologies at the level of the city authorities and the quality inspection and certification of road product, application in study hours in training specialists for transport of Ukraine, use for scientific research of the transport university have been performed. Publications are based on the research provided by the grant support of the State Fund For Fundamental Research.


1. Ніконов О. Я., Полосухіна Т. О. РОЗРОБКА ІНТЕЛЕКТУАЛЬНИХ ІНФОРМАЦІЙНО-КЕРУЮЧИХ ТЕХНОЛОГІЙ ДЛЯ ЕФЕКТИВНОСТІ ЗАСТОСУВАННЯ ТРАНСПОРТНИХ ЗАСОБІВ

Запропоновано веб-технології для високоекфективного застосування транспортних засобів з дотриманням вимог надійності, безпосередньої роботи, паливої економічності, безпеки додатків, навколишнього середовища, ергономіки и т.д. Розроблено транспортний портал і прототип інформаційно-комунікаційного комплексу.

2. Никонов О. Я., Полосухіна Т. О. РАЗРАБОТКА ИНТЕЛЛЕКТУАЛЬНЫХ ИНФОРМАЦИОННО-УПРАВЛЯЮЩИХ ТЕХНОЛОГИЙ ДЛЯ ЭФФЕКТИВНОСТИ ПРИМЕНЕНИЯ ТРАНСПОРТНЫХ СРЕДСТВ

Предложены веб-технологии для высокоэффективного применения транспортных средств с соблюдением требований надежности, безотказной работы, топливной экономичности, безопасности приложений, окружающей среды, эргономики и т.д. Разработан транспортный портал и прототип информационно-коммуникационного комплекса.

3. O. Nikonov, T. Polosukhina DEVELOPMENT OF INTELLIGENT INFORMATION AND CONTROL TECHNOLOGIES FOR EFFICIENCY UPGRADEING OF VEHICLE APPLICATION

Web-based technologies for highly efficient application of vehicles with the observation of requirements of reliability, no-failure operation, fuel efficiency, application safety, environment, ergonomics etc. are proposed. The transport portal and a prototype of the information and communication complex have been devised.