THE INTEGRATED CLIENT SERVER COMPLEX OF GEOVIDEO FOR FIELD SURVEY OF THE HETEROGENEOUS DATA CHARACTERIZING HIGHWAYS

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Summary: *Accounting technology characteristics of highways using automation technology to automate video monitoring activities on a comprehensive assessment of highways, to provide an objective and consistent account of the condition of the road infrastructure. Recommendations on the use of video monitoring to create the monitoring, recordkeeping, and client- server model of highways.*

Authors propose an approach to video monitoring is aimed at improving the accounting systems used by the data on the state of engineering structures. Key technological means of video monitoring of engineering data transport performance road tested and practically applied in the production of specialist ONIL CAD GIS MADI.

Keywords: *data integration, engineering, construction, accounting and engineering data, software and hardware, video monitoring, roads, geoinformation technology.*

For complex control of the state property and target allocation of the means selected for development and the content of highways, it is necessary exact and trustworthy information about a state of a network of highways. For directional actions these tasks should dare on the basis of the objective data characterizing a road condition. Information banks of the road data should lean against the structure providing survivability both protecting integrity and a correctness of the data from errors of input, from incompatibility of different measuring apparatuses at carrying out of researches.

Since 1998 laboratory "Geotrans" MADI produces operations on researches of highways with usage of geoinformation technologies and GNSS (GLONASS/GPS). Thus titles more than 15 000 federal, territorial, municipal highways the general expansion more than 25 000 km that became a basis for mass data acquisition about a state of objects of a road infrastructure with the subsequent creation of cartographical servers and electronic passports of highways and projects of the organization of driving have been fixed with subcentimetric accuracy.

Timeliness of obtaining of the actual engineering information, safety of the data received as a result of surveys and their serial accumulation can be carried out, creating the modern interactive basis with possibility of the infinite addition and the instant update of the data.

Following data is necessary for creation of such basis on engineering constructions:

1. The Actual data under geometrical characteristics (to 3D-model, maps, plans).

2. Administrative, title, address, objective identification.

3. Indexes GNSS (a local and global location) on objects of observation.

4. Video data of panoramic monitoring of high resolution in archive and real time [1].

Set enumerated above the data allows to create an interactive platform - the control server the engineering data - cartographical and tabular (for example www.geotransport.ru/kartogrs.shtml, fig 1).

Cartographical service of Russia

Cartographical service Moscow city.

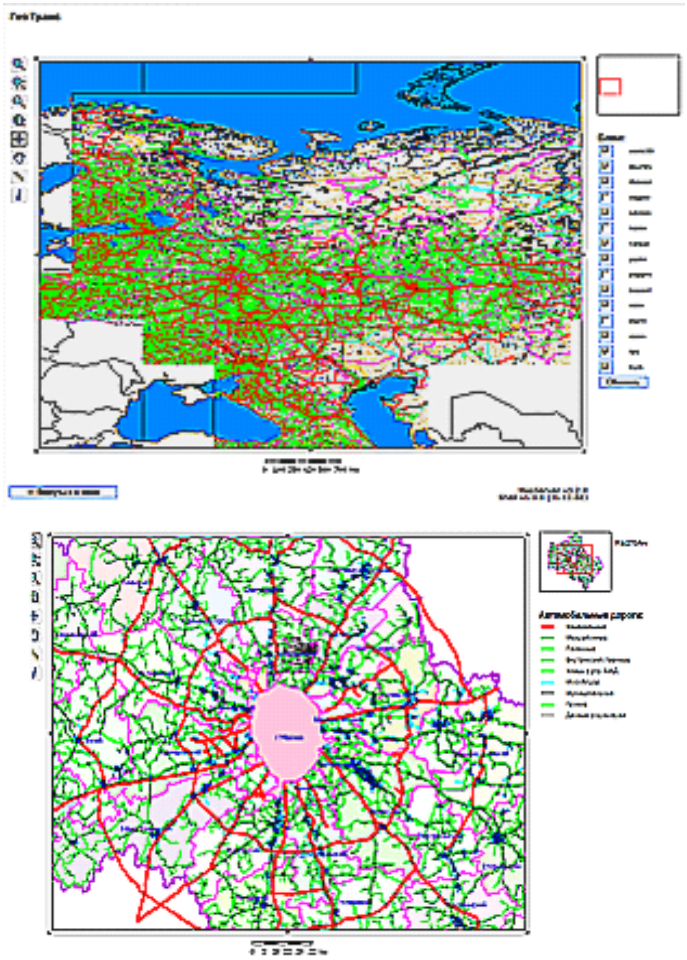


Fig 1. *Examples of server geomanagement information systems engineering constructions and interactive cartographical service.*

On the basis of the cartographical server it is possible to form a databank on engineering constructions which can contain full-scale quantitative and qualitative characteristics of elements of engineering constructions, quantitative and quality indicators of elements of engineering constructions, analytical notes and reports, video data for a decision support.

For control of heterogeneous data arrays about a state of highways it is necessary to use the modern high-efficiency automated hardware-software complexes (HSC, fig 2) mass collection of the road data.

Laboratory "Geotrans" - the leader in development of technologies of integration of the heterogeneous data at program and hardware level, preparation of experts, manufacture of operations on data management of monitoring of engineering constructions (collection, storage, provision, the analysis) [2]. One of our development - client server technology of monitoring of roads HSC Geovideo.

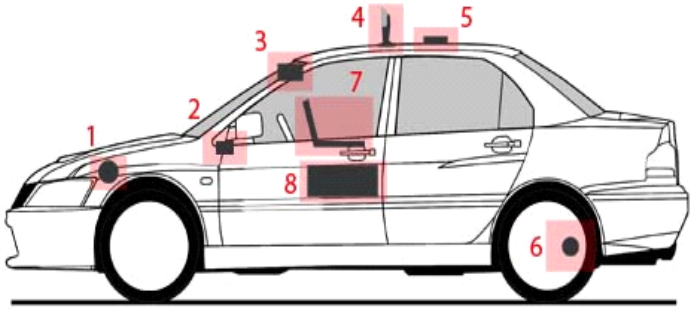


Fig 2. *Sites of components PAK Geovideo in the car*

1. Optical sensors profile-meter. 2. System of determination of the linear location. 3. Cameras of panoramic shooting. 4. The optical sensor of a vertical clearance. 5. Antenna GNSS. 6. Inertial system of angular position. 7. The computer automobile. 8. The switching and supply integrator.

Geovideo system is based on principles of the automated obtaining of data array from the sensors interpreting a location and the characteristics of road objects and elements [3].

Into equipment of road laboratory enters:

The video monitoring device (cameras of high resolution Full HD, HSC video capture and cameral handlings);

The position fix device (the GNSS-RECEIVER, the sensor of the transited way, HSC adaptive calibration the transited way);

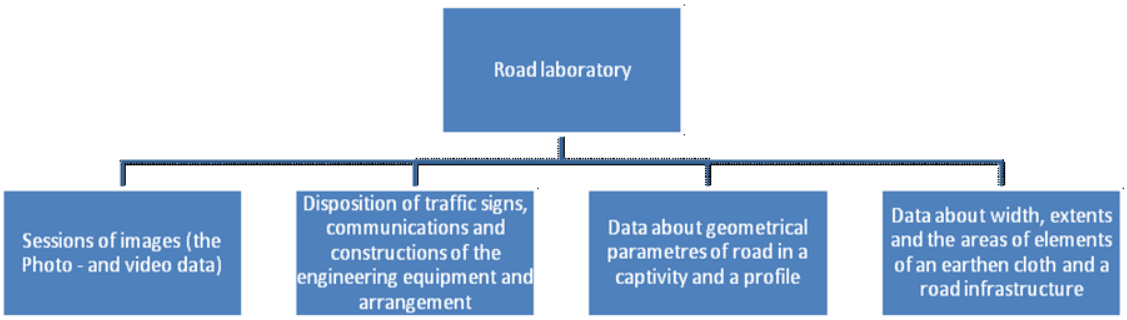
Optical (laser, profile-meter) a subsystem of fixing of a location and-or characteristics of objects (flatness, horizontal and vertical clearances, a location);

The additional device of determination of cross and longitudinal geometry of road and HSC filtrations of stray indications (inclinometer, Mini gearbox system, inertial system);

The on-board computer (a supply 12V) with the geoinformation software.

The situation and road conditions acts in film by means of portable and-or fixed in salon of road laboratory of cameras of high resolution with possibility of night shooting and date transmission on Ethernet.

The scheme of a complex of the data received by road laboratory:



The binding of objects is carried out by means of adaptive HSC position fixes (the GNSS-RECEIVER and the sensor of the transited way). I.e. at confident reception of a signal (more than 7 companions) are carried out calibration subsystems of the sensor of the transited way by means of the GNSS-RECEIVER, and at entrance on terrain sections where reception is complicated, switching on the sensor of the transited way is carried out. Limitation of both methods is considered and mutually compensated at a shooting stage.

Source of the data, a part HSC Geovideo (a geoinformation component, group of sensors, the GNSS-RECEIVER and cameras), form units of the heterogeneous data. Each of these units is valuable in itself and in some cases allows to solve the task, being used independently. So, for example, one it is enough for creation of the plan of a high system. However in industrial cases simultaneous usage of the heterogeneous data is required. Thus they should be coordinated and synchronized.

In the unique general parameter given by any source of information gathering, time is. Every portion information are logical for adding record about time of its obtaining, and afterwards to use these records for the coordination. GNSS-RECEIVER time, obviously, is reference, and the computer is synchronized with it by laboratory operation.

Handling of the received data array is carried out in cameral conditions.

The program complex represents a dial-up of the applications specially developed for operation with great volumes of the data (accumulation more 100Mb on 1km shootings with frequency 1 frame/meter).

Composition PAK includes the application allowing interactive to interpret geometrical parameters of road on a dial-up of points of shooting of a location. The action principle is based on mathematical functions of approximation. The program allows to construct a longitudinal profile of existing road, to produce the list of angles of rotation, straight lines and curves, as the initial data using absolute high-rise marks of points of a route. In the course of formation of visual model stray races of the heights connected to quality GNSS of communication, are corrected filtered) automatically.

The set of programs for the video shooting equipment includes the program of field video capture and the program cameral handlings. At the beginning of shooting the operator in the program brings the data about removed road (the road code). In the course of shooting on the

computer screen the information on characteristics of an engineering construction for a current location is interactive deduced.

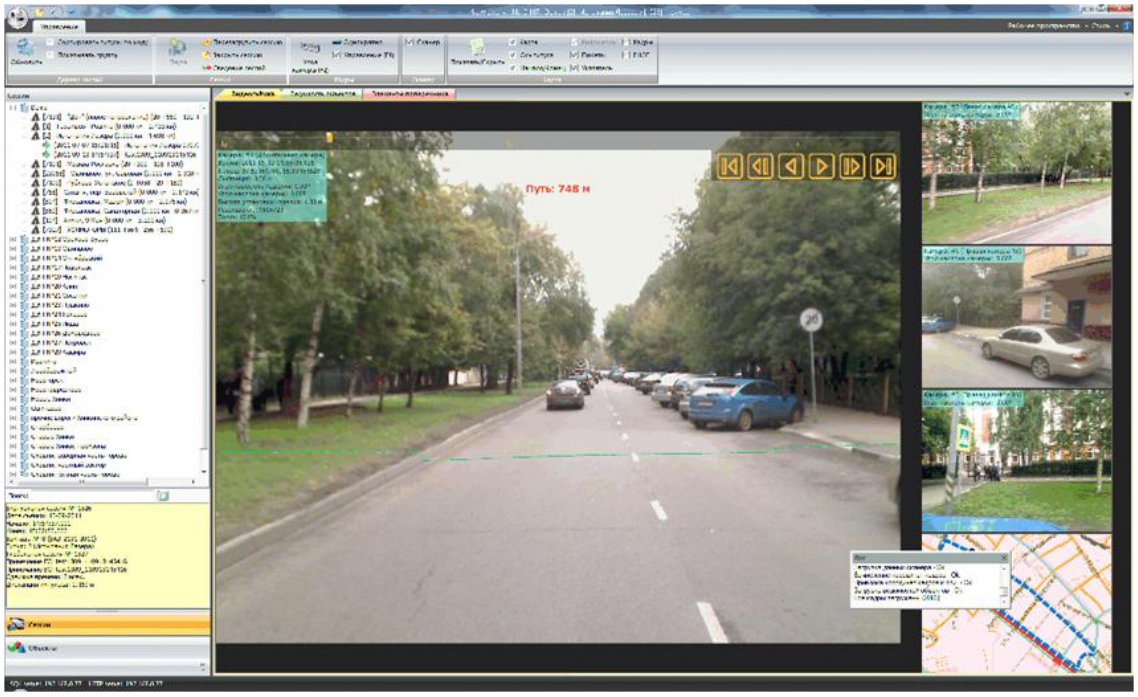


Fig 3. *The interface of the program of Geovideo*

Geovideo program has been developed with usage of the modern programming methods that allowed to lower the requirements shown to computers on which the program is used. For operation with the program of enough office computer. For operation with the program it is not required special skills of possession of the computer and vocational education. Intuitively the clear interface, tooltip balloons and the torn operating instructions of the program allow to master the program quickly.

The simplified system of input of objects, measurements of parameters (width, biases and so forth), is reduced to that the operator should click with a mouse on object and into appropriate fields to enter its parameters. The big basis of reference manuals of objects, operation possibility on a network from an every spot on the globe reduces time for data handling. The expanded search in type and parameter allows to find the necessary object quickly. Possibility of usage of several cameras, allows to process objects behind a roadside. If shooting has been produced with the bad quality (blacked out and other), there is a possibility of adjustment of display of frames (clarification, shading, contrast and other).

Road shooting can be produced as in direct, and a backward direction, the program considers a direction of shooting for simplification of the further data storage. There is a possibility of review of a location of object on road by means of the circuit of road (plan).

The program allows to save coordinates of objects which can be used further with GIS-PROJECTS.

In road practice it is accepted to submit data a road infrastructure the linear binding concerning the beginnings of road or concerning the nearest smaller kilometer pointer of km +.

At export of the data from the program of Geovideo the binding of objects is geographical in Cartesian coordinates (XYZ). For passage to the linear binding the object is projected on an axis of a route of a highway with known coordinates.

On fig 4 the objects exported from Geovideo in a tabular type are shown, on fig 5 - the same objects are presented geographically in GIS, where yellow points - objects, and a red line - a highway concerning which it is necessary to calculate the linear binding.

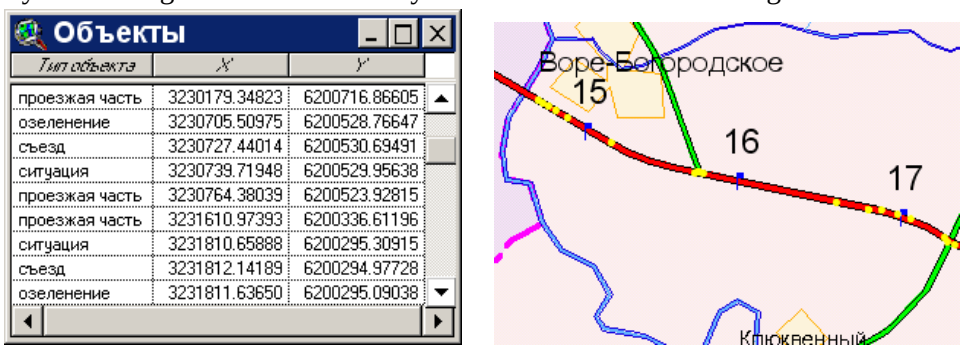


Fig 4. *objects with coordinates X, Y, Z; fig. 5 - objects on a card*

At a following stage the data about an infrastructure, geometrical characteristics and a situation on a highway with the linear coordinates is imported to a DBMS. By means of requests for each type of objects tables and balance sheets of a demanded type are automatically formed, and the absolute linear binding concerning the road beginning is replaced with a binding concerning the nearest smaller kilometer pointer as it is accepted at road workers for registration guiding (fig 6, [4]). The Same database can be used, for example, as a source of the data for creation of the linear schedule at carrying out of certification of highways (fig 7).

Ведомость наличия и технического состояния автобусных остановок

	Местоположение, км+				Названия	Наличие элементов			
	справа		слева			Остановочная площадка с твёрдым покрытием (есть, нет)	Переходно-скоростные полосы (есть, нет)	Посадочная площадка (есть, нет)	Павильон
	1	2	3	4	5	6	7	8	9
1			25	977	Макарово	есть	нет	есть	металл
2			28	156	Кресты	есть	есть	есть	металл
3	28	268			Кресты	нет	нет	есть	ж/б
4			32	208	АБЗ	есть	есть	есть	металл
5	32	322			АБЗ	есть	есть	есть	металл
6	34	85			Буреломка	есть	есть	есть	ж/б
7	34	678			В/ч	есть	есть	есть	металл
8	35	132			с.Чапаева	есть	есть	есть	металл
9	35	821			Ямкино	есть	есть	есть	металл
10			36	7	Ямкино	есть	есть	есть	металл
11	36	248			Ямкино-2	есть	есть	есть	металл
12			36	549	Ямкино-2	есть	есть	есть	металл

Fig 6. *a fragment of the list of the passport of a highway*

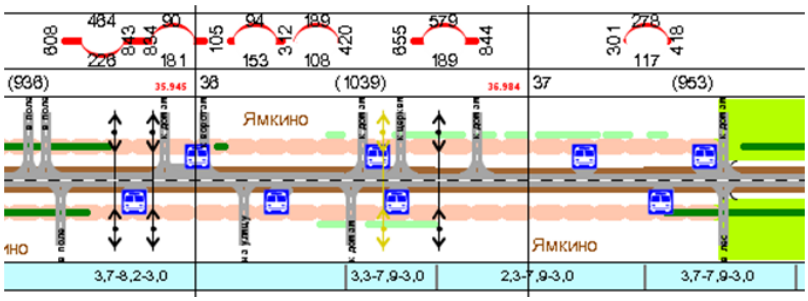


Fig 7. *a fragment of the linear schedule of the passport of a highway*

Thus, the full stroke, since data handling of a video shooting and fixation of demanded objects in the program of Geovideo, their subsequent linear binding, formations of balance sheets, displays of the cartographical information, and also possibility of export of the data in any format (dbf, txt, xls etc.) turns out.

As a result of manufacture of operations following tasks in sphere of the registration of highways and the state property are solved:

· Support of recurrence of all types of measurements on road on the basis of the fixed network of highways;

· Minimization of subjectivity and the human factor at the expense of application of the formalized tools of control and supervision (GNSS, GIS, video monitoring);

· Streamlining and fastening of titles of highways (an accessory, boundaries);

· Fastening of all objects of an infrastructure and the driving organization (in 4 systems of position fix);

· The extension of possibilities of used bank of the road data (cartographical service, a coordinate binding of objects, a databank of video monitoring of high resolution with an interactive space binding);

· Join of the information collected by the various organizations and tools, in uniform information field, thereby providing objectivity, control (on early (field) stages - self-checking), recurrence of measurements, effective information representation (adequate for capital-intensive engineering constructions - highways).

By our experience, usage of geoinformation projects in practical operation allows to raise considerably efficiency of accepted decisions on various questions of control and development of a network of highways that has repeated acknowledgement in road controls of the Moscow region. Operations of experts MADI are highly estimated by all road organizations. Substantiating their scientifically-methodical, and the main thing with practical skills, we generated the powerful analytical tool for creation of a uniform information system of highways.

References

[1]. Поспелов, П. И. Видеомониторинг улично-дорожной сети / А. А. Котов, П. И. Поспелов // Дороги Содружества Независимых Государств. – 2011. – № 21. – С. 78 – 81.

[2]. Котов, А. А. Мобильный видеомониторинг транспортных потоков для автоматизированного учёта интенсивности дорожного движения в районах малой инфраструктурной доступности/ А. А.Котов, П. И. Поспелов // Вестник МАДИ. – 2013. –Вып. 4(35). – С. 11 – 18.

[3]. Руководство по использованию ПАК Геовидео®. [Электронный ресурс]. – Режим доступа:www.geovideo.ru, свободный. – Геотранс (дата обращения 20 ноября 2013 года).

[4]. Поспелов, П. И.Управление инженерными данными компонентов модели жизненного цикла автомобильной дороги / П. И. Поспелов, А. А. Котов, Г. А. Федотов // Вестник МАДИ. – 2012. – Вып. 4(31). – С. 93 – 97♦