Satellite Monitoring of Mobile Objects

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SUMMARY

The operating navigation GIS for cities of Irkutsk, Angarsk and Shelehov, providing monitoring of moved objects, is considered. When creating maps of these cities, the partial refusal from the character map and transition to the map photographic was used. Also to user the possibility is submitted to be on a map, to come nearer to the selected object and in details him to consider.

One of the most modern innovations of technologies oriented to a broad circle of the users in many spheres of human activity is the technology of satellite systems of positioning (SSP) or navigational systems. We understand positioning processes of measurements executed with the help of satellite systems with the purpose of determination of coordinates of finding of the spectator or object in three-dimensional earth space [Serapinas, 1997].

One of the spheres of application of SSP technology is the urban transport systems. By virtue of territorial distribution they become by ideal object of automation by means GIS, as space component is the natural basis of integration of the various tasks having the attitude to transport. Let's consider some of them [Andrianov, 2007].

The standard optimization tasks of transportation (task of logistics). The simplest task is the delivery of freight from point and in point on the shortest route (or route with the least cost). For its solution it is necessary to have downlink and topology of a correct road network. The following task is the direct-sales representative. It is necessary to go round preset number of points for minimum time (or at a minimum path length). In this task the same factors, as in the task of search of the shortest route are taken into account. And, at last, classical transport task requiring such organization of routes of transportations, at which the demand of customers in transported from the suppliers (manufacturers) the product will be completely satisfied at the least total cost of transportations.

The geoinformation technologies allow not only to plan transportations, but also to inspect them: to find out deviations from the schedule of motion, to arrange to their elimination, to predict time of delivery and to inform the customers.

Some of such tasks:

- Analysis of transport load and condition of a road cloth;
- Monitoring motion;
- Assembly of statistics on performance of a subordinated road network;
- Analysis of emergencies;

- Planning and analysis of an enroute network;
- Scheduling;
- Coordination of time-tables with other types of transport.

Since 2007 the faculty of an engineering geodesy and cartography of Irkutsk state technical university (EGC ISTU) together with the company «Magic Systems» develops the project called "INFOSITY" [Plusnin, 2008]. The purpose of the project is the creation of a multi-purpose geoinformation system integrating in a large spectrum of various geotools. "INFOSITY" – charge-free geoinformation software product containing valuable three-dimensional model of cities of Irkutsk, Angarsk and Shelehov, telephone quick reference containing more of 8000 organizations and firms, geobound virtual panoramas both photos of city and organizations, and as initially built-in valuable on-line tools of monitoring of any mobile objects.

The executed activity consist of creation of a transport (automobile) navigational system for agglomeration of Irkutsk – Angarsk – Shelehov, basing on a carefully executed map of the pointed cities in a scale 1: 10 000. The cartographical activities are executed by the employees EGC ISTU. The maps composed under the data DL from satellites EROS-A and EROS-B with the spatial sanction on district 1.9 and 0.7 meters accordingly.

Standard procedures of processing Satellite snapshots and high-precision coordinate binding of the maps to the topographical basis previously were executed. Then the automated decoding of objects of space snapshots is made: structures, roads, reservoirs, sites of wood vegetation with subsequent векторизацией of objects and formation of a data base (DB). The created DB allows an information system to execute functions of the electronic quick reference – search of object to the address, name, and telephone number.

At creation of maps agglomeration of cities the approach distinguished from creation of conventional maps and the atlases was applied. The partial failure from the character map was used and in a number of cases was branched to the map photographic, a capability the user also was simulated to be «on a map», being transferred on it [Berlyant, 2006]. For this purpose the data placed in base, did not limit by a usual text – digital signature. In the basis accommodation of the additional information as virtual panoramas and virtual rounds is incorporated.

Virtual panoramas and rounds – one of most effective at present of ways of representation of the information, as they allow making the fascinating of virtual excursions and create for the user full illusion of presence. So, in a course "of travel" it is possible to approach or to remove any object, to look round on the parties, in detail to consider separate details of object, to survey a panorama from apart, to look upwards – downwards, to come nearer to a selected point or to be deleted from it, through active zones to be transferred from one panorama on another, for example,

“to take a walk” on separate premises etc. And all this it is possible to do in the necessary rate and in the order, convenient particular user.

The basis of virtual round is made by (with) spherical photos (panoramas) giving a capability of the full review (view) “around of” (360x360 of degrees).

There is a capability to add anyone three-dimensional models (if necessary transferring in real time). In the current version there are the examples of accommodation of buildings, bridges, building sites, stops, and also publicity boards. (Fig. 1).

Fig. 1: A fragment of a three-dimensional map (Irkutsk)

In further it is supposed to cover more than halves of area of cities real 3D with models of buildings and facilities, the activity in the given direction conducts permanently. For increase of productivity of a system the radical optimization of a load and response of the program will be made, the search capabilities are processed. Updating a system 2 times per one year is supposed.

In a geoinformation system "INFOSITY" the on-line tools GPS/GSM of monitoring of any mobile objects is built initially – in. (Fig. 2)

There is a capability to inspect site of objects in real time, to view routes of movements for any period, and as to form the reports of movement for any period.
As a result of activity above the project "INFOSITY" maps for usage in navigational devices of corporations GARMIN, NAVIGATOR with the established program NAVITEL are also developed. The data of a map allows automatically to create a route of motion in view of an urban decoupling, to make address search and other functions dependent on the software established in device (Fig. 3)

Fig. 2: A fragment of a map with a function of monitoring of a vehicle

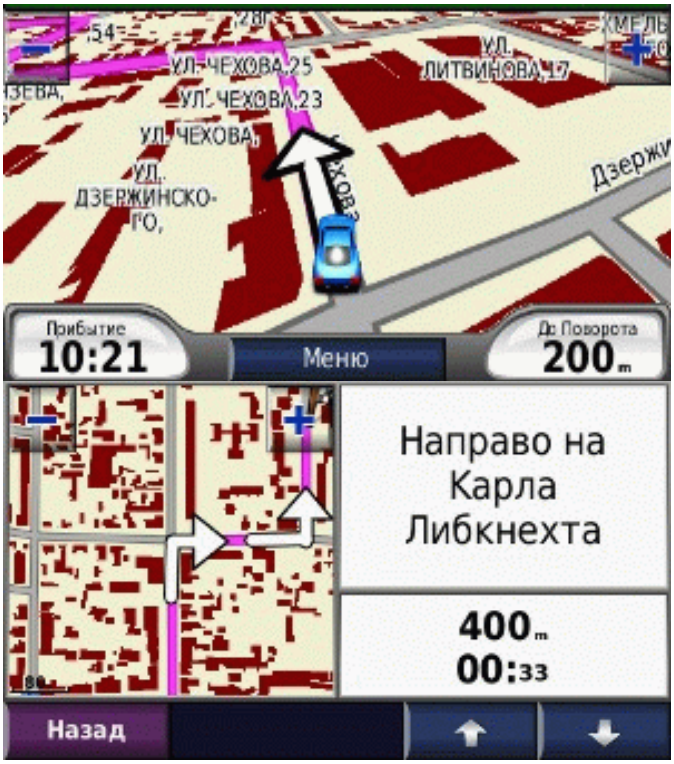

Fig. 3: A fragment of a map from the navigational device GARMIN with the route of motion

In final realization of the program all capabilities of security monitoring, control of fuel and control of activity of any aggregates and gears, removal, review and storage of photos from cameras connected to devices will be added and as social tools (capability to add the friends and to see their objects on a map in the access).

Thus, the system "INFOSITY" integrates in itself an electronic map, function of the electronic quick reference, advertising means, and means of monitoring of mobile objects.

Let's summarize. As a result of performance “INFOSITY” we receive data sets – linear objects displaying a trajectory of motion of all vehicles, connected to a system and dot objects – units displaying place of a stop of automobiles. The system records, in what instant each of machines is in the given point on a track (or on “parking”) and saves a trajectory of motion of the automobile in a DB of dispatching center.

We already spoke, that as a result of broad demand the transport information is valuable resource, and the value her consists, including, in uttermost objectivity of this information, that is determined by a way of its obtaining.

It is uneasy to see, how the available data can be used for the solution listed before the tasks. Usage of the data of our SSP in statistical and monitoring the tasks – purely system is obvious and is intended for this purpose. In the tasks of logistics in main (basic) the exact electronic maps and analytical capabilities GIS with connected optimization modules are used. For the analysis of emergencies the data of dispatching center about trajectories of motion, time and rates of the participants RTI are used. At realization of an estimation of transport load and condition of a road cloth we use the data about total of passing automobiles, their characteristics (it is possible, received from a DB of firms – owners of vehicles or State inspection of safety of road motion), characteristic of a road cloth, including normative (received from appropriate road services). The simple statistical calculations give the answer to put questions, besides, constant and, on the first sight, the unmotivated build-down of transport load on some site of a road can to testify to deterioration of a condition of cover (coating) of this site etc.

The implementation of these tasks will require some additional costs:

Organizational – tolerance to data bases of the interested departments with the subsequent granting of own results;

Scientific – selection and analysis of available developments, adapting them under the put tasks, determination of the necessary inquiries to a system and creation for them of standard templates, and also creation of new algorithms and programs;

Technological – assuring compatibility of a SSP with received or created modules and, for certain, other costs to anticipate which occurrence now it is inconvenient enough.

It is necessary also to mark, that the regular obtaining valuable space and attributive of the information enables constant actualization of digital cartographical materials and semantic data bases, capability of simulation analysis and "playing" of a plenty of versions of development of territories, and also their visual representation, ecological monitoring, creation of the cartographical and semantic basis multifunction territorial GIS.

Well and, at last, major for us a direction – training of the students. We already marked [Pankratov, 2008], as far as is more active and with large interest the students to learning process concern, when they in hands have means of the analysis and synthesis of objects of an investigated subject. Usage GIS as educational technology allows receiving in essence new results. At usage of conventional technology of training, for example, geography (maps, geographical atlas, statistical tables, and text – description) as the final purpose memorizing some volume of an educational material is considered. At the best is a mastering by the pupil of certain legitimacies in spatial phenomena, and at usage of GIS-technologies the trainee first of all takes possession of the instrument of an establishment of communications between these phenomena – simulation analysis of process of formation of these legitimacies. At a level of modern methods of knowledge (computer simulation analysis) there is a reduction of a gap between state of-the-art of a science on the one hand and contents of the educational programs and, especially, their implementation, to another [Razumovskaya, 1997].

REFERENCES

Andrianov V.V., 2007. DATA+. GIS and transport. ArcReview № 3 (42)

Berlyant A.M., 2006. The theory of geomaps. - 262 p. – M.: GEOS

Pankratov V.S., Klevcov E.V., 2008. Complex usage remote of exploration of the Earth and geographical information system in the educational process // The receiving tank of the proceedings 8-th release. Problems of mastering of mineral base of Eastern Siberia. Irkutsk: publishing ISTU

Plusnin U.N., 2008. Geographical information system «Infositi». Electronic resource: www.3dirk.ru

Razumovskaya N.V., 1997. Usage of geoinformation technologies in the system of common derivation, Newsletter, GIS Association, №3 (10) 1997

Serapinas B.B., 1997. Satellite positioning, Newsletter, GIS Association, №3 (10)

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