

intelligent transport systems; intellectual analysis of data  
monitoring; routing; navigation database

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## DEVELOPMENT OF TECHNICAL SOLUTIONS FOR REALISATION OF INTELLIGENT TRANSPORT SYSTEMS

**Summary.** This article focuses on the development of architecture and technical solutions for implementation intelligent transport systems (ITS). The presented system will perform the following functions: monitoring the movement of an object collecting and displaying information about the state of the road, warning of the approaching object to obstacles, routing, as well as control of movement and speed of the output parameters of the recommendations of the movement, the development of intelligent decisions about the choice of optimal routes, intellectual analysis of data (IAD) of the style and movement of the driver (the influence of alcohol), IAD on the technical parameters of the vehicle. Thus, it is advisable for ITS to be divided into several subsystems, which are related but are responsible for one or more functional tasks. Consequently, the need for monitoring the movement subsystem, the database on the state of the object database on the location of an object, display subsystem, the subsystem of control of the road, the engine safety (prevention of obstacles), the subsystem control parameters of movement, routing subsystem.

## РАЗРАБОТКА ТЕХНИЧЕСКИХ РЕШЕНИЙ ДЛЯ РЕАЛИЗАЦИИ ИНТЕЛЛЕКТУАЛЬНЫХ ТРАНСПОРТНЫХ СИСТЕМ

**Аннотация.** Статья посвящена разработке архитектуры и технических решений для реализации интеллектуальных транспортных систем. Представляемая система будет выполнять следующие функции: мониторинг движения объекта, сбор и отображение информации о состоянии дороги, предупреждение о приближении объекта к препятствиям, маршрутизация, а так же контроль скорости движения и вывод рекомендаций о параметрах движения, разработка интеллектуальных решений о выборе оптимальных маршрутов, интеллектуальном анализе данных (ИАД) о стиле и движении водителя (влиянию алкоголя), ИАД о технических параметрах транспортного средства. Таким образом, целесообразно ITS разделить на несколько подсистем, которые будут взаимосвязаны, но отвечают за одну или несколько функциональных задач. Для реализации этих функций, необходима подсистема мониторинга движения, база данных о состоянии объекта, база данных о местоположении объекта, подсистема отображения информации, подсистема контроля дороги, подсистема безопасности движения (предупреждения о препятствиях), подсистема контроля параметров движения, подсистема маршрутизации.

## 1. INTRODUCTION

Recently, in today's large metropolitan areas there is a significant increase in congestion of highways, in consequence, the increasing intensity of road transport acute need for effective regulation of traffic flows. These problems raise questions relevant traffic safety on the roads. For road safety, transport logistics tasks, ensuring the comfort of road users and inform them about the current state of the transport network to reduce the physical and financial costs, the possibility of a timely response to the dangers when driving simple monitoring of mobile objects is not enough. To solve these problems it is advisable to use the intelligent transport systems (ITS), which combines all the above features. Creating a unified architecture allows the ITS to monitor three main areas:

- Safety. The main goal – reducing accidents on the roads. It also includes monitoring of natural and man-made disasters.
- Mobility. Gathering information about traffic from moving in the flow of vehicles and informing road users.
- Protection of the environment. Reduce environmental damage from vehicles by monitoring the situation in real time, and timely decision-making.

## 2. COMPOSITION OF INTELLIGENT TRANSPORTATION SYSTEMS

This article focuses on the development of architecture and technical solutions for implementation (ITS). The presented system will perform the following functions: monitoring the movement of an object collecting and displaying information about the state of the road, warning of the approaching object to obstacles, routing, as well as control of movement and speed of the output parameters of the recommendations of the movement, the development of intelligent decisions about the choice of optimal routes, intellectual analysis of data (IAD) of the style and movement of the driver (the influence of alcohol), IAD on the technical parameters of the vehicle.

Thus, it is advisable that ITS be divided into several subsystems, which are related but are responsible for one or more functional tasks. Consequently, the need for monitoring the movement subsystem, the database on the state of the object database on the location of an object, display subsystem, the subsystem of control of the road, the engine safety (prevention of obstacles), the subsystem control parameters of movement, routing subsystem [1].

### 2.1. The subsystem monitor traffic

This subsystem is required to track the current location of the object, recording the location, monitoring the passage of a given route. To implement this system can be based on the AVL system, which uses global satellite navigation. The subsystem on-board set a system is shown in Fig. 1.

Board set the transport facility is designed to obtain information about its current coordinates the collection of information from external sensors, archiving, data transformation and conservation in non-volatile memory.

On-board kit consists of the following hardware:

- Navigation GPS receiver and antenna (one case);
- Intelligent controller.

Fig. 2 shows a general functional diagram of the on-board kit.

### 2.2. Databases

For the Intelligent Transportation System to two databases. The first is a database on the state of the object, which will include online data obtained from the motion control subsystem, namely, speed, distance traveled, time, motion, time, motion, without stopping, the number of stops of the object.

Also, this database will contain information on safety systems - the coordinates of obstacles and dangers on the route of movement, but also record messages and notifications that need to convey to the user system. The second database – the navigation database. It is formed by the monitoring subsystem. That is obtained from the device to write data reported by GPS navigation sensor in the format of NMEA, namely GPGL, formed by a set of coordinates and time of movement of the object. These databases are used by virtually all the subsystems of intelligent transportation system.

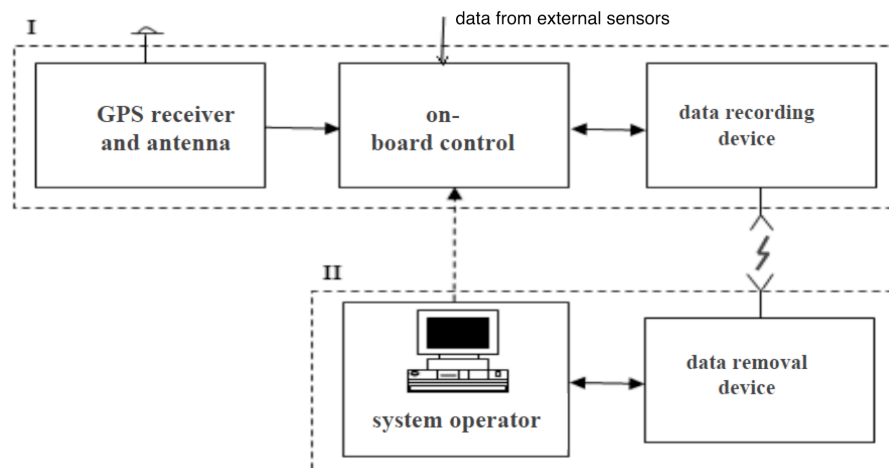


Fig. 1. Functional diagram of the subsystem location of the object

Рис. 1. Функциональная подсистема размещаемая на подвижном объекте

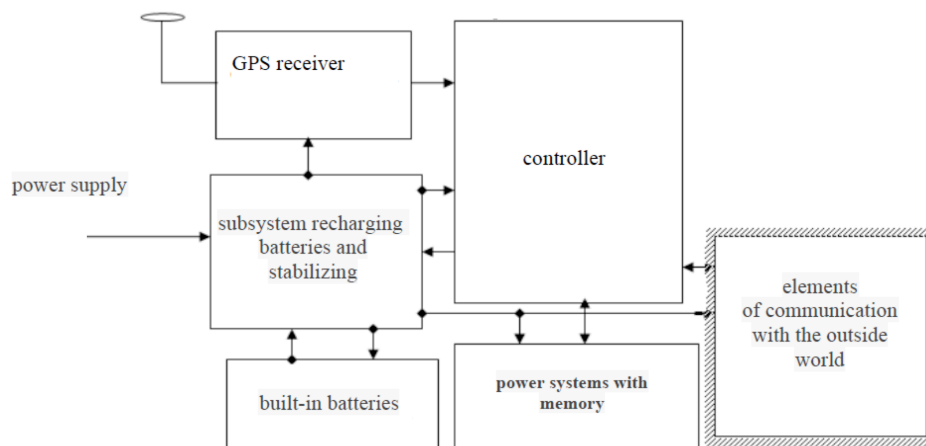


Fig. 2. Functional diagram of the board set

Рис. 2. Функциональная система бортового комплекта

### 2.3. Display subsystem

The system is designed to display the results of the system: the location on the map, the coordinates of obstacles and dangers on the road map of the route or movement of the program on the map, the map a route to overcome the subject, displaying messages from the security system. The work of this system can be divided into two types - work with cartographic information and work with messages. Working with messages based on the work with the database state. Working with Cartographic

information implies the presence of a digital terrain maps. It is advisable to use vector maps, as they contain not only the image area, but also, primarily, a set of data about the objects areas, transport networks, topography, etc. The structure of the vector map is shown in Fig. 3.

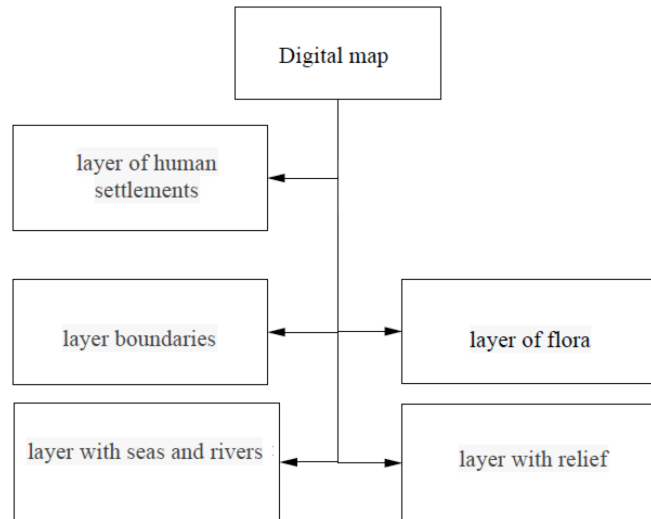


Fig. 3. The structure of the vector map

Рис. 3. Структура векторной карты

Displays information from the navigation database is using real mathematical coordinates binding to the sheet maps and its size, the rate of one-degree steps on-screen pixel.

## 2.4. Control subsystem of the road

The operation of this subsystem is to monitor the status of the satellite line of the road in order to detect obstacles to free movement (road works, traffic jam etc.) or of any hazards (falls, skids on the road, the accident). Functional diagram of the control subsystem of the road is shown in Fig. 4.

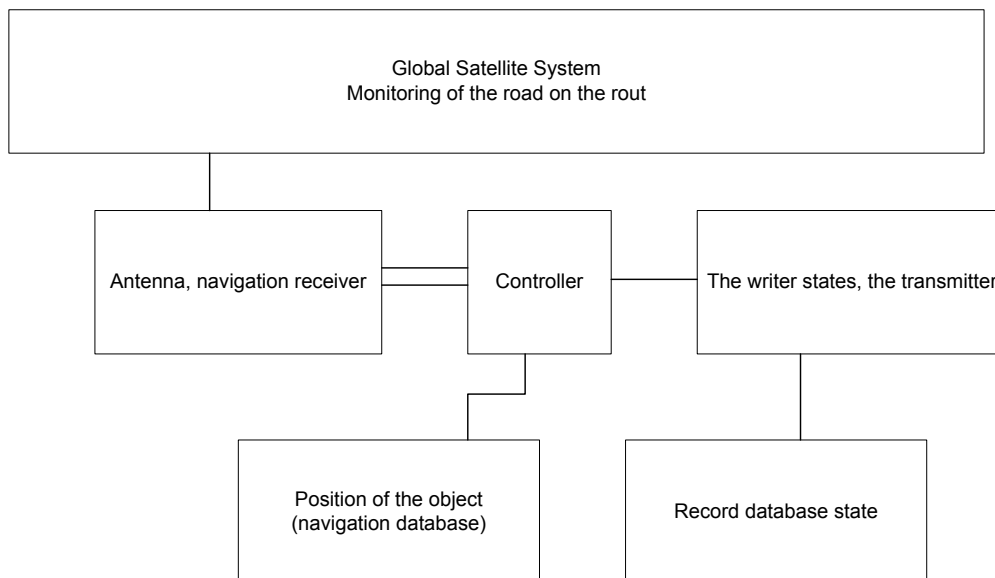


Fig. 4. Functional diagram of the control subsystem

Рис. 4. Функциональная схема системы оборудования

## 2.5. Subsystem routing. The subsystem parameters control the movement

Subsystem routing is necessary for laying, constructing and displaying routes and best routes to save time, energy and economic resources. Implemented using software, based on the algorithms on graphs, in particular, depth-first search, Dijkstra's algorithm, I\* and greedy algorithms. Control subsystem is a subsystem of parameters of motion information processing in order to transform the data into the navigation database data in the database state by using mathematical calculation speed and distance from the known coordinates of time and movement.

## 3. MODEL INTELLIGENT TRANSPORT SYSTEM

### 3.1. The information model of ITS

Based on the analysis of the interaction of subsystems of Intellectual Transport System together can build an information system model. This model is presented in Fig. 5 [2, 3].

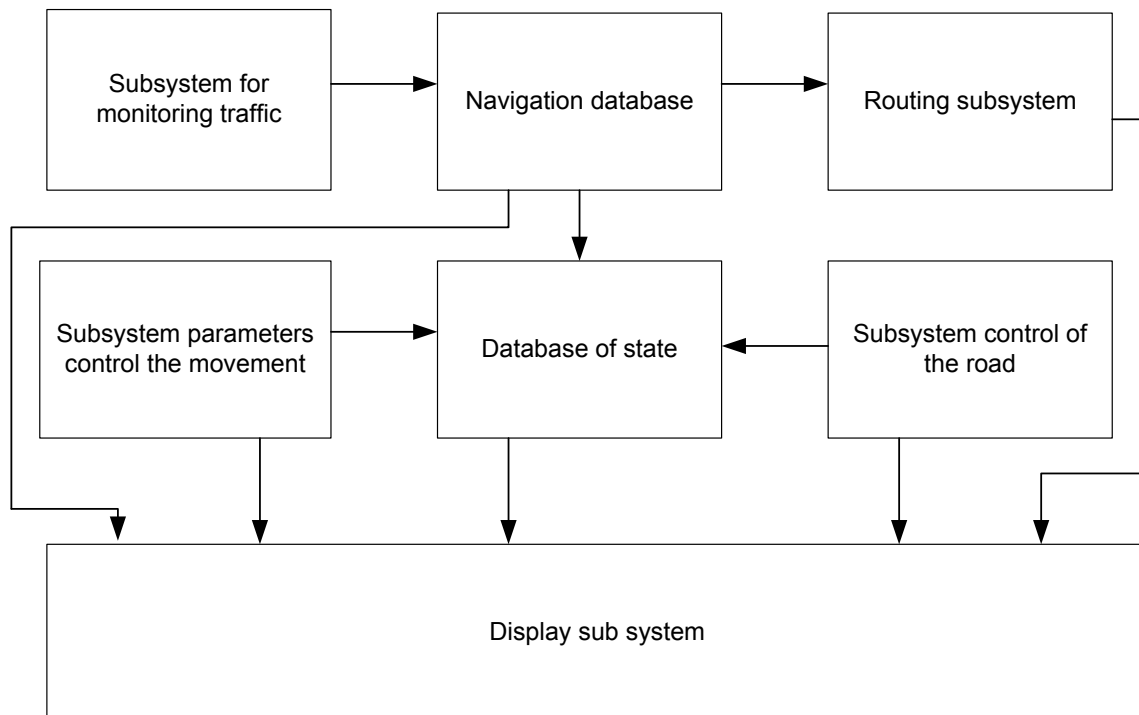


Fig. 5. The information model of ITS

Рис. 5. Информационная модель ИТС

### 3.2. Functional diagram of ITS

To implement the ITS developed the following scheme (Fig. 6) [3].

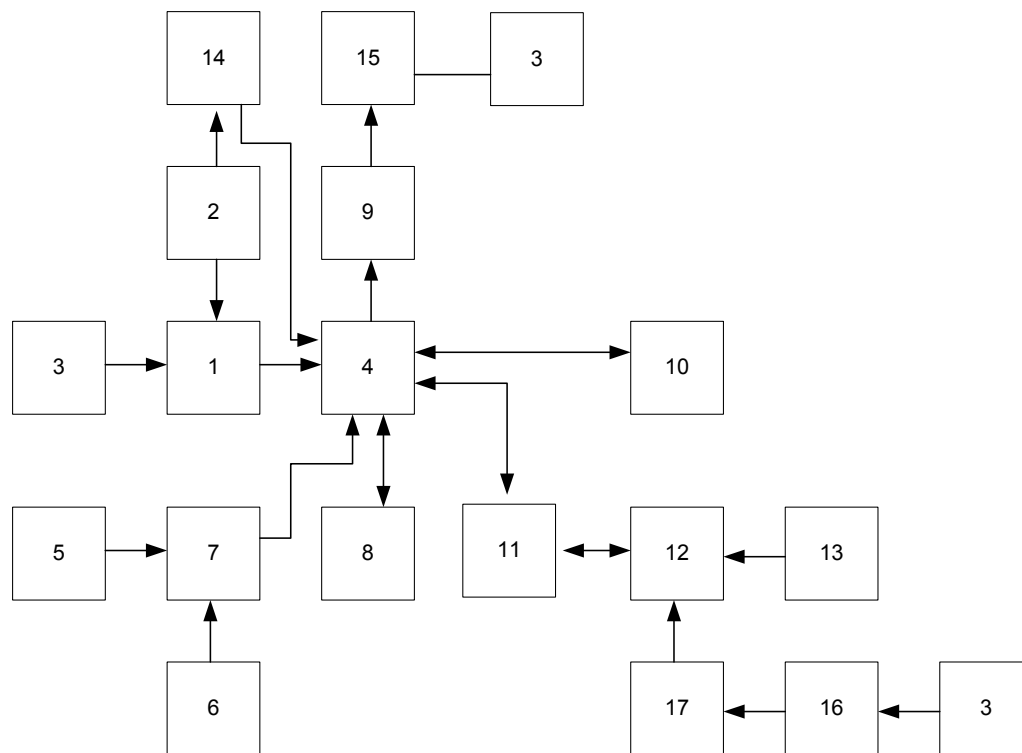


Fig. 6. Functional diagram of ITS

Рис. 6. Функциональная диаграмма ИТС

Where:

- 1 - The receiver of a moving object
- 2 - The moving object
- 3 - Global Satellite System
- 4 - Managing Controller
- 5 - Power Supply
- 6 - Battery
- 7 - Subsystem stabilize supply
- 8 - Memory
- 9 - The device is displaying map information
- 10 - Nonvolatile information sohranitel
- 11 - Wireless transmitter of information
- 12 - Central Station
- 13 - Cartographic Information
- 14 - Power sensor motion parameters
- 15 - The device for calculating and recording data on the state of motion parameters and the state route
- 16 - The local radio
- 17 - Transducer terrain data

#### 4. CONCLUSIONS

Intelligent transportation system is a complex of different subsystems, whose work is aimed at providing comfort, safety and economy of motion. What are the important factors in how the intensity of traffic increasing day by day. The introduction of ITS is able to solve many transportation problems

[4], and the quality of the existing different systems increases, the system they themselves acquire new properties.

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