Structural and intelligent scheme of navigation system of a ground-based mobile robot for forming a traffic route

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Abstract. At the beginning of Russian studies on the task of creating mobile ground fire robots for use in extreme situations in late 1980, it was justified by the fact that firefighters need protection when dealing with the consequences of accidents in areas with high levels of radioactive pollution. The use of fire robotics was increase because of a large number of technogenic accidents. There was a need for use of fire ground robots, where emergency situations, fire, and technogenic accidents arise because it's dangerous for the life and health of firefighters and people. Fire mobile ground robot is an automated self-propelled technical device which does given commands of human and other actions without human. People use this robot at the accident on area, where is dangerous for the health of firefighters things are situated like oil, nuclear, chemical objects. Now we are considering a structural and intelligent navigation system of fire mobile ground robot, in which a structure of fire robot must create a good way to the center of ignition, control parameters of motions, track own location for safe navigation and improvement tactical of opportunities of the firefighters. The introduction of a fire mobile ground robotics device is needed for an increase in the tactical capabilities of fire detachments during the extinguishing of the fire. The goal is to the definition of tasks and development structural and intelligent scheme of the navigation system of fire mobile robot for the shortest path to fire and extinguish a fire.

1. Introduction
A robotics device is an automatic device which is designed to perform motor and highly intelligent human functions.

Robotics devices became an important part of our industry in the twenty-first century.

Now we are going to consider a mobile robot for use in emergency situations which is name EL-4.

The robot’s task is to do emergency rescue work on the free part in the territory, on the warehouse and on the production facilities. Also, it does transport fire extinguishers things and does fire extinguishing work in the conditions of technological accidents. Besides, it disassembles constructions for passage to fire.

The mobile robot is regulated by a routing computer or by radio with support for the TV radio module or by a cable that connects with the sensor system, control system, and communication system. Program product and the structure of regulation of the robotic device have a component scheme, do improvement in part of revisions, implement noise immunity, to test of reliability improvement, self-diagnosis. Besides, they carry out auxiliary goals and increase other tactical and technical parameters [1].
The Mobile robot has sensors and with them, it estimates an environment that surrounds it, also it has a chain of precise effects for the sake of influencing the environment and the concept of control, which provides to do directed and practical operations for robotics device.

A robotics device uses remote detectors, temperature sensors, chemical element sensors, radiation sensors in emergency situations, and it uses motor devices for the perception of its environment.

In a circular structure, elements make the control mechanism work, in relation to changes in the environment. Consequently, it is feedback. If the control mechanism is exposed at the right time, the sensors indicate this change by sending a message about the environment to the control system.

2. Materials and Methods

The use of such a robotics device in emergency situations will be able to eliminate the threat to the health and life of the human operator. Also, it is important to form a navigation system structure that will make a map of the environment where mobile robotics reproduces the route leading to the landmark and can bypassing the obstacles encountered on the way.

The main method of controlling the navigation of a mobile robotics device is performed in the return of tasks, where from values with the highest degree of abstraction to levels with the lowest degree of abstraction, and data about the state of the robot pass in the opposite direction. At any given degree, navigation saves a map of the robot's own working area and contains special video sensors with visual probability.

Imagine that the outer environment isn't considered in the source period and the mobile robotics device is in the middle of an arbitrary area (in picture 1 it's numeral 0), where it is the formation of the coordinates of the constitute map, as shown in picture 1 [2].

Areas 1,2,3,4,5,6,7,8 are accepted as potentially passable. The inspection begins with the first section. Movement is performed in the direction of the middle of the initial section only if this section is free.

Based on this, we can make a map of the territory, as shown in figure 2 [3].

![Figure 1. Map of the robot’s trajectory](image_url)
Figure 2. Sequence of drawing up a map of the area

Ultimately, we extracted the result, as shown in picture 3 [3].

Figure 3. Passage of the optimal path of the linear production and dispatch station "Cherkasy».

After creating a map of the environment, the robot uses it in the process of moving to the goal. The structure of regulation by a mobile robotics device solves given tasks:
- data processing to collect information about the work and the environment around it;
- processing data from the interface to the operator;
- event planning for the understanding of the main task and the sequence of subtasks for further execution of the main task;
- creating a software path for moving the mobile robot;
- drawing up actions at the robot’s executive mechanisms [4].
3. Discussion
One of the peculiarities of constructing concepts for managing a highly intelligent mobile robotic device is that it is based on a hierarchical multi-level principle and with an increase, the hierarchical rank of subsystems its level of intelligence development also increases. The action management system is considered the highest component of this hierarchy, next is the movement management system, and the punctual mechanism management system is considered the lowest component of this hierarchy [5]. In addition to these subsystems, there is an information and measurement system in the structure, which is still required to possess some mental probabilities and an interface with the operator.

The action control system is pre-defined to create a reasonable maneuver of the robotic vehicle to complete the task set before it.

The motion control system is designed to plan the software trajectory of the mobile robot.

The control system of the precise device centralizes the plan of the actuators of the mobile robotic device [6].

The information and measurement system is designed to collect, process, and transform sensory data into signals.

We can conclude that the creation of mobile robots for production purposes will be relevant. Thus, the robot's task is to study the environment in order to make a map and find a goal, form a map of the environment, and find the optimal path. Based on this, the application of the described method allows quick building of a map of the external environment and effectively plans the trajectory of movement to the goal. This application of the mobile robot will improve the tactical capabilities of firefighters, strengthen the level of protection against fire hazards [7].

4. Conclusion
The use of a mobile robot will remove the health and life threats of people. In addition, a system of navigation can make up a map, in which a mobile robot is functional, and robot plans a route, which leads to the goals and can avoid obstacles, which encountered on the way.

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