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Organizational and managerial issues of improving the fire safety of the protected objects

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Introduction. The paper considers the issues of modernization in the field of fire safety. It is noted that insufficient attention is paid to the tasks of fire safety management of the protected objects, and this negatively affects the overall level of security in the regions. The most relevant and effective method of improving the fire safety of the protected objects is the active introduction of robotics and artificial intelligence.

Problem Statement. The objectives of this study are to develop proposals to improve fire prevention and fire protection systems, as well as to create a set of measures aimed at ensuring fire safety.

Theoretical Part. The works of scientists on the topic of this study are used as basic information. The system of fire safety organization, legal regulation and state measures in the field of fire safety have been studied.

Conclusions. The results of the study can be used in practice to ensure the fire safety of the protected objects, as well as for further scientific research.

Keywords: fire safety, objects of protection, robotics, artificial intelligence.

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Introduction. The development of complex technologies, the activities of large industries and urbanization significantly increase fire danger of the protected objects. The occurrence of fires in large administrative, sports and educational complexes with a significant number of people can result in injuries and casualties.

The factors that arise as a result of a fire exceed other high-risk incidents in terms of danger of negative consequences. Therefore, it is necessary to pay special attention to such tasks as creating conditions for preventing fires, successfully extinguishing them, and timely evacuation of people. This will significantly reduce the damage from fires and the number of victims.

Problem Statement. The current level of development of digital technologies allows us to constantly improve the efficiency of fire robots. This technique, along with traditional approaches, has proven itself well in emergencies. In the field of automatic fire fighting equipment, the use of robotized installations is set by law. As for mobile robotized technology, the issue requires serious improvement. Based on scientific materials, it is necessary to formulate proposals for improving fire safety of the facilities.

Thus, V. V. Kiselev considers it optimal to ensure fire safety through the introduction of robotics[1], A. Lazarev — with the help of artificial intelligence (AI)[2].

Theoretical Part. Automatic fire fighting equipment can significantly reduce the number of victims and damage from fires. Automatic fire fighting systems are a necessary component of fire protection of any object. This is especially true for objects with crowds of people.

[1] Kiselev V. V. Perspektivy primeneniya robototekhniki v oblasti obespecheniya pozharnoy bezopasnosti. Aktual'nye voprosy sovershenstvovaniya inzhenernykh sistem obespecheniya pozharnoy bezopasnosti ob'ektov: sb. mat-lov VII Vseros. nauch.-prakt. konf., posvyashch. 30-i godovshchine MChS Rossii. Ivanovo, 2020. p. 144-148 (In Russ.)

[2] Lazarev A. A. Aspekty primeneniya tekhnologi iskusstvennogo intellekta v nadzornoy deyatel'nosti MChS Rossii. Id. p. 144–148. (In Russ.)

Another element of developing fire technologies is fire robots. They are already in service with the fire department. Their purpose is to facilitate the work in extinguishing fires and eliminating the consequences of emergencies, to ensure the safety of people at enterprises with increased radiation and chemical risks[3].

As a rule, fire robots are made on the basis of wheeled or tracked vehicles and extinguish fire with water and foam. Fire robots of various modifications are distinguished by special elements that determine the functionality. The main distinguishing feature of the fire robot is the possibility of remote control. The software allows you to set fire extinguishing parameters, ensuring high efficiency of fire fighting. This is the main function of the fire robot, but it can also transmit data from the work site. To do this, the car is equipped with video cameras and infrared scanners. Computer processing of the video image allows you not only to observe the process of extinguishing the fire, but also to determine the parameters necessary for greater extinguishing efficiency: the area of the fire, the location of the fire source. The operator determines the trajectory of the robot.

Another advantage of robotic fire extinguishing means is the possibility of round-the-clock use for monitoring the protected object. If a fire is detected, the robot can perform its extinguishing function without an operator's command. Conventionally, fire robots can be divided into three types:

1) android robotic systems,

2) mobile fire robots,

3) stationary automated installations.

In Russian practice, the RSS fire robot is successfully operated, which can transmit video to the operator's screen. It extinguishes the fire with a compact jet of water, foam or powder. Such equipment is used in places of mass gathering and enclosed spaces: tunnels, storage facilities, etc. [1].

It is also worth noting the mobile fire-fighting robotic complex of the MRK-RP light class. Its brief description can be presented as follows: a set of mechanisms and devices for eliminating the consequences of accidents is installed on the tracked chassis, if there are explosive objects in the accident zone or there is a risk of harmful substances being released. The main working tool of such a robot is a manipulator. The electric drive expands the scope of its application [2].

The country also produced heavy robots — "El-4" and "El-10". They were mounted on a tracked chassis, equipped with fire extinguishing equipment and containers with fire extinguishing agent. The main purpose of such equipment is to work in terms of radiation exposure. The disadvantage is low mobility[4].

Let us move on to the use of artificial intelligence in the field of fire safety. In this field, AI is mainly used for:

1) processing an array of information when planning inspections,

2) object surveys,

3) monitoring the Internet and social networks,

4) monitoring of objects and territories of settlements.

In the first case, we are talking about establishing the facts of re-inclusion of objects in the annual inspection plans. In addition, unplanned objects and expired inspection periods are identified. The AI toolkit allows you to exclude other planning errors, including those of a technical nature [3]. You can configure the AI solution in such a way that it calculates the time of inspections, distributes it between the supervisory authorities and at the same time takes into account data on supervision of small businesses, microenterprises, branch network.

[3] Skripnik I. L. Prognozirovanie i raschet pokazateley nadezhnosti sistem avtomaticheskoy pozharnoy signalizatsii. Monitoring, modelirovanie i prognozirovanie opasnykh prirodnykh yavleniy i chrezvychaynykh situatsiy: sb. st. po mat-lam IX Vseros. nauch.-prakt. konf. Zheleznogorsk, 2019. p. 438–444. (In Russ.)

[4] Pokrovskiy A. A. et al. Realizatsiya informatsionnykh i professional'no orientirovannykh obrazovatel'nykh tekhnologiy v uchebnom protsesse. Sovremennye problemy vysshego obrazovaniya: sb. mat-lov VII Mezhdunar. nauch.-metod. konf. Ivanovo : Ivanovskaya pozharno-spasatel'naya akademiya GPS MChS Rossii, 2015. p. 44–49. (In Russ.)

In the second case, the following are involved:

— robotic equipment (wheeled or tracked mechanisms, as well as quadrocopters),

— wearable means,

— connection to the object's video surveillance systems,

— combinations of the listed solutions[5].

The functions that AI implements when examining objects are described below.

1. Application of technical measurement tools, including measurements of:

a) geometric dimensions of objects, escape routes, exits, distances;

b) illumination of premises;

c) noise pressure;

d) pressure parameters generated by smoke removal systems and (or) low air in case of fire;

e) temperature of objects, as well as wires, cables, etc.

2. Analysis of materials, including:

a) results of control and observation;

b) administrative documents;

c) projects (section of fire prevention measures) in comparison with regulatory legal acts and taking into account their relevance;

d) the project (section of fire-fighting measures) in comparison with the actual state of affairs;

e) characteristics of the object of supervision and their comparison with regulatory legal acts;

f) placement of evacuation plans, signs, fire safety signs, etc.

3. Monitoring of visits to premises according to the plan of the building (structure).

4. Scanning the actual state of affairs at the facility and calculating the individual (social) fire risk based on the results of the site visit.

5. Photo, video, audio recording

The implementation of the third direction of application of AI technologies makes it possible to use big data to identify objects of supervision[6].

The fourth direction involves monitoring using the satellite technology and outdoor video cameras. Let us list some of its tasks:

— to detect fire-hazardous objects and garbage,

— to locate the building of bonfires,

— to control the placement of vehicles and maintenance of fire hydrants.

Monitoring at the protected facilities will allow you not only to identify violations of fire safety requirements, but also to exclude the cases of false triggering of automatic fire alarms and prevent costly and unsuccessful response to them by fire departments.

Conclusions. This paper provides a brief analysis of decisions and actions aimed at modernizing fire safety of the protected facilities.

Currently, the main task facing the creators of fire robotics is to increase the level of autonomy of machines.

Modern development of technological processes should stimulate the creation of new intelligent solutions in the field of fire safety. That is why fire robotics is constantly improved and is increasingly used in the work of fire and

[5] Semenovich S. Okhrana po ostatochnomu printsipu. Kommersant". 2012;55:27–28 (In Russ.)
[6] Lazarev A. A., Chesnokova L. N. Pozharnaya opasnost' shou myl'nykh puzyrei. Pozharnaya i avariynaya bezopasnost': sb. mat-lov XIII mezhdunar. nauch.-prakt. konf., posvyashch. Godu kul'tury bezopasnosti. Ivanovo, 2018. Chast' I. p. 146–145. (In Russ.)

rescue departments. This makes it possible to reduce the professional risks of firefighters and increase the efficiency of their work [4].

References

1. Meshcheryakova A. M., Akopyan E. A., Slinin A. S. Artificial intelligence in medical imaging. Main objectives and development scenarios. The journal of telemedicine and e-Health. 2018;3(8):98–102 (In Russ.)

2. Puchkov P. V. Shnekorotornoe robotizirovannoe ustroystvo dlya vypolneniya avariyno-spasatel'nykh rabot na trudnodostupnykh territoriyakh. NovaInfo. 2020;111(1):11–12. (In Russ.)

3. Puchkov P. V., Kiselev V. V., Toporov A. V. Razrushenie stroitel'nykh metallokonstruktsiy v usloviyakh pozhara. Scientific and educational tasks of civil defence. 2010;3:29–32. (In Russ.)

4. Poroshin A. A., Kondashov A. A., Sibirko V. I., Goncharenko V. S. The state of fire alarm systems at protection facilities from 2016 to 2020. Safety of Technogenic and Natural Systems. 2021;3:40–46. Available from: https://doi.org/10.23947/2541-9129-2021-3-40-46 (accessed: 03.09.2021). (In Russ.)

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Contribution of the authors

A. S. Netrebin, V. A. Bokova —formulation of the basic concept, goals and objectives of the study, calculations, preparation of the text, formulation of conclusions; D. V. Totskiy — scientific supervision, analysis of research results, revision of the text, correction of the conclusions.