UDC 519.6: 681.3(045)

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**Unmanned aerial vehicles application in the emergency situations**

*The report considers the main areas of application of unmanned aerial vehicles in emergency situations. The main types of UAVs used for liquidation of the consequences of emergency situations were considered.*

**Unmanned aerial vehicles for emergency situations.**
Unmanned aerial vehicles (UAVs) are used in many areas of human activity, including their use in case of emergency situations. In case of emergency situations, UAVs are used in different scenarios and different types of UAVs are used [1].

UAVs are used to monitor and eliminate the consequences of emergency situations. The purpose of this application for the UAV is to conduct a structural analysis of the emergency zone, analyze the environment and use this information to forecast the development and eliminate the consequences of emergency situations.

Information fusion and situational awareness of an emergency situation. UAVs are more often being used to help emergency response services gain situational awareness — whether it be assessing the scale and impact of a natural disaster, managing traffic after a road collision happened, or continuing to monitor an emergency. The synthesis of information is necessary and useful at all stages of disaster management, and its most important impact is observed at the assessment stage. The purpose of information fusion and sharing of information is to bring together different sources of available information and/or create a link between different information technologies that can be used in another application for disaster management [2,4].

Aerial photography from UAVS can help create a picture of an emergency during or after an event so that the true scale and impact can be explored and the damage caused by the emergency can be assessed. Aerial photographs can be combined with existing maps, and overlaid with the names of streets and buildings on aerial photographs to create a picture of the area and help with reconstruction or additional resources that may be required. It is also important to assess the damage caused by an emergency using various methods, such as monitoring the condition of structures and video inspection using UAVs [4].

For these emergency response UAV applications, UAVs of similar types and configurations are used. UAVs for monitoring and acquiring emergency data can be fixed wing, multi-rotor or helicopter type designs and can be used over wide areas for application. They can carry a variety of payloads, which includes high-resolution cameras and thermal imaging cameras, LiDAR scanners, multispectral sensors, gas and chemical pollution sensors [6].

Autonomous communication system. Providing an autonomous communication system using UAVs utilizes the purpose of restoring the communication infrastructure damaged or destroyed as a result of emergency situations, is an urgent task in the aftermath of a natural disaster. Especially relevant is the use of such a communication system at the stage of response by the relevant services in the emergency zone and in the process of restoring a permanent communication system. UAVs for an autonomous communication system required to be able to stay in the air for a long time [2].

Search and rescue missions. The purpose of using a UAV for search and rescue mission is to search and rescue people who are lost, trapped by debris, injured or immobilized during an emergency. UAVs with thermal imaging cameras are used during search and rescue operations at night, in places with thick foliage or in the case of victims who are trapped under the rubble. With the help of these cameras operators can easily spot people using their body heat, and built-in GPS systems, standard on most drones, can accurately determine the location of the victims. UAVs with on-board searchlights, combined with real-time streaming video, are used to illuminate night rescue operations, which allows to increase the efficiency of searching large areas in a short period of time. UAVs equipped with zoom cameras are used in situations where a specific person needs to be identified in a crowd (or among debris or other distractions), the ability of most UAVs cameras to zoom in allows for easy and accurate face identification. [2,3].

UAVs for search and rescue missions can be fixed-wing UAVs, quadcopters, multicopters and unmanned helicopters, which have various advantages and disadvantages in performing search and rescue operations. Fixed-wing Search and Rescue UAVs usually flies faster and operates at higher altitudes, they can operate longer and therefore have a longer range than quadrocopters and multicopters.

Multi-rotor UAVs and unmanned helicopters capable of vertical takeoff and landing (VTOL) and can be launched from a much more restricted area, and they don't need a runway or a launching mechanism such as a catapult. Multi-rotor drones are more maneuverable than fixed-wing platforms and can hover in place, providing a more stable platform for imagining.

Hybrid VTOL UAVs take off with the help of rotors and then transition to horizontal flight. This gives hybrid VTOL UAVs the operational advantages of a multi-rotor UAV, as well as the extended range and coverage of a fixed-wing UAV.

UAVs used in search and rescue operations may need to detect and avoid collisions with objects such as trees, power lines and helicopters. This is especially actual for UAVs which can operate autonomously, which may be required when used in mountainous or urban areas, as well for areas where radio communication can be difficult. When operating in these regions, on terrain or in areas of water covering large areas, the UAV may also need to operate beyond line-of-sight.

Search and rescue UAVs can carry different payloads, including thermal and visual cameras, mobile phone detection systems, and devices that can drop iems such as radios, food and water, medicine, and life-saving supplies.

In addition to live video feeds, images can also be helpful in search and rescue missions as the resolution of still cameras is usually much higher than that

found in video cameras. The images can be sent back to the ground control station to create maps of the area based on the latest information. Maps created with precision geospatial analysis software cam indicate search areas with high probability based on the target's last known location and heading [5].

Reconstruction of the place of an emergency situation. Creation of high-quality 3D images and maps in the emergency area based on operational topographical surveying using specialized equipment and software installed on board of the UAV. 3D images can be used during search and rescue operations, maps can be useful for locating and assessing structural damage to buildings and other infrastructure in affected areas, as well as for starting major reconstruction work [3].

Various types of UAVs can be used for creating 3D maps. Many consumer UAVs can be used to create 2D and 3D maps, any UAV with a good camera can be used for this purpose. However, there are dedicated UAVs for this task that have more advanced features, which includes long flight times, professional cameras, autonomous flight modes, GPS correction technology and longer transmission ranges. UAVs for 3D imaging have been designed to operate in the bad weather conditions, so they will not be limited in terms of where and when we can used them [7].

A common UAV design for this application is multi-rotor VTOL UAVs.

Delivery of emergency goods. Often after a disaster, when it needed most, traditional lines, which used for communication and delivery, are not available. In this situation, drones can be used not only to restore communication between the parties, but also for delivering essential items such as food, water or life-saving medical supplies to those who need it. While roads, rail, and water may be temporarily unavailable, in most cases air will be available. Drones can perform these tasks much faster than traditional methods, with the benefit of keeping additional personnel away from potentially dangerous areas [4].

UAVs for the delivery of emergency goods have different configurations, which are determined by the object to be delivered, the task, and where we need to deliver it. Common UAV configurations for delivery are quadcopters, multicopters and fixed wing UAVs. The main advantage of quadcopters for emergency delivery is the ability to take off and land vertically, which allows us to deliver emergency goods to any point. The disadvantages of this design are low range, speed and altitude, which limits their use. Fixed-wing UAVs can fly faster, higher, and have longer range than quadcopters, but they require more space to take off and land, which limits their use.

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