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# The future is in robot collaboration

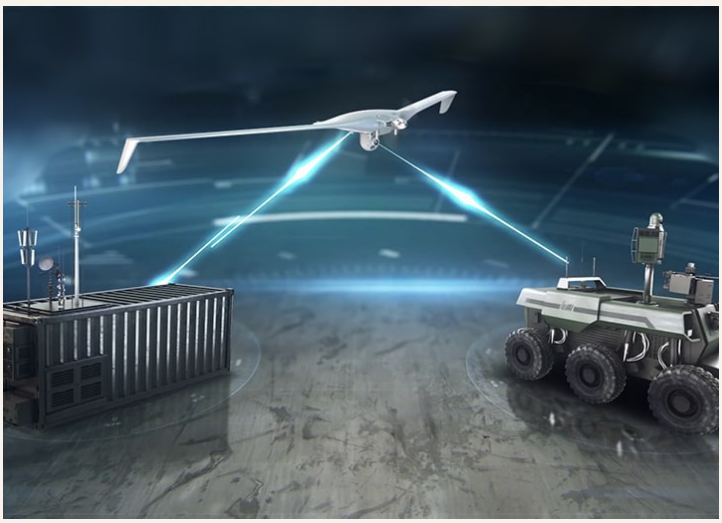
We decided to dedicate our next issue to one of the most promising areas in robotics - **the technology of group control of drones**. In recent years, hundreds of companies, including the LeoTronics Robotics, and universities worldwide have been engaged in such research. The developers are faced with creating a complex algorithm to teach drones to act in a group.

At the same time, the electronics will be able to correct the received tasks. In this way, the artificial intelligence of the system will be formed. There is a strict hierarchy of control levels. At the top of them, there is a human operator. But in an exceptional situation, one of the robots with greater computing power can take over the control.

## Applications

In this interaction, aerial drones support ground groups of robots (unmanned ground vehicles - UGV). The use of such a combination increases the degree of effectiveness of the tasks solved with the help of a group of robots, which can be very diverse. Among them:

- Search and evacuation of victims during rescue operations in emergencies and natural disasters. Aerial and ground drones, combined with artificial intelligence, can find and evacuate victims with minimal intervention from operators. At the same time, they can perform such functions in extreme conditions for humans and in hard-to-reach places
- Assisting oil workers, polar expeditions, and other special units and objects in distress cut off from the outside world
- Firefighting
- Performing peacetime and combat reconnaissance missions
- Fulfilling the functions of security, law enforcement, and safety of territories and facilities.



With regard to the last paragraph, not so long ago, the **Pentagon ordered a control system of maritime space**. It combines several detachments of air and surface drones. They will be able to take control of the territory of hundreds of nautical miles.

## Interaction technology

It is supposed to use two types of robots in the project - aerial and ground. A group of small drones should determine the coordinates, for example, in distress. The drones will act as a maritime survey of the route and create an electronic map of the area.

A ground unit - amphibious robotic platforms - will perform the search and transportation of people in distress. Drones in this combination also perform human evacuation functions. Autonomous aerial vehicles and autonomous ground vehicles can eliminate much danger for military personnel working in hazardous areas.

## Examples of pilot projects and trials

Carnegie Mellon University (CMU) teamed up with Sikorsky Aircraft to use an autonomous helicopter and a robotic ground vehicle to demonstrate what can be achieved by combining the capabilities of the most advanced unmanned vehicles.

**The simulated mission** took place **at the Sikorsky Technology Launch Center**, using an autonomous ground vehicle developed at Carnegie University called the Land Tamer and a Sikorsky UH-60 MU Black Hawk helicopter. In 2014, the potential of an aircraft with an optional unmanned control function was first evaluated for use in the U.S. Army for autonomous cargo delivery.

In its latest test, which was actually announced nearly 18 months ago, the Black Hawk carried the Land Tamer 19 kilometers in suspension before lowering it to the ground for further autonomous travel overland. The rover traveled a set route of 10 km, using built-in chemical, biological, radiological, and nuclear sensors to detect simulated chemical, biological and radiological hazards. The information collected was transmitted to a remote ground station where researchers could closely monitor the Land Tamer to investigate suspicious locations.

This demonstration followed **a similar event at Fort Benning, Georgia**, involving an unmanned K-MAX helicopter and a ground robotic vehicle to support the Army branch created by Lockheed Martin.

Also, as in the previous test, the developers' main goal is risk reduction, the ability to reduce danger to military personnel by combining the skills of autonomous aerial vehicles and ground vehicles.

**According to the developers, combining drones and unmanned ground vehicles, which was recently demonstrated, has enormous potential to bring the emergence of advanced flexible, modular, intelligent vehicles for units that can deploy as quickly as needed to counter ever-changing threats.**

Chinese engineers have experience creating an algorithm that allows **a drone and a ground robot to jointly develop a map of the environment and avoid obstacles**. Experiments have shown that this method enables the background to be explored faster than the identical vehicles alone.

**Engineers led by Shaojie Shen of Hong Kong University of Science and Technology** decided to combine different types of vehicles into a single system that works more efficiently than identical vehicles on their own. Unlike other experiments, in this one, they decided to use a drone as a full-fledged, rather than a backup, data source.

The developers created an algorithm that constantly builds a map of the area and plots objects. In doing so, a boundary is formed between the explored and unexplored areas. The robot path planner is designed to constantly update the path and sends the robot to the longest part of the boundary, thus encouraging exploration of the largest unexplored areas.

When designing robots, engineers choose their design based on the task the device will perform. For example, ground-based robots can carry a reasonably massive payload or many sensors and tools to interact with the environment. Drones, such as multicopters, also have advantages, including traveling faster and exploring a wider area.

The engineers carried out two types of experiments - in an actual room measuring 17 by 8 meters and a virtual space measuring 20 by 20 meters. During the experiments, the machines worked together or individually. The experiments showed that in all types of environments (virtual and real), the cooperation of the two types of devices allows them to make a complete map of the room faster than when working alone.

Engineers built a four-wheeled robot with lidar and a quadcopter with a downward-facing stereo camera to create a map of the area themselves. As they move around, the robot and drone create a single map of the terrain in real-time, with obstacles mapped. It allows them to avoid wasting time exploring an area if the other machine has already collected data about it.

## Prospects

According to experts in robotic systems, combining different automatic systems under common control seems very promising. Such projects are isolated and unique and are certainly helpful from a practical and scientific point of view.

They can serve as an impetus for developing this technology around the world. The main obstacle to implementing this system may be the project's economic feasibility.