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THE CONCEPT OF A HYBRID MOBILE ROBOT

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ABSTRACT

The article considers the concept of a hybrid mobile robot that combines the capabilities of a walking platform and a quadcopter. The proposed system provides effective adaptation to complex terrain and the ability to switch to air mode to overcome obstacles. The design features, control algorithms, and energy consumption optimization are analyzed. Potential areas of application include rescue operations, military reconnaissance, and exploration of hard-to-reach areas.

1. INTRODUCTION

Relevance of the research Modern combat and reconnaissance operations require high mobility and autonomy of technical means. The use of mobile robots significantly expands the capabilities of military units in difficult conditions, ensuring the safe conduct of operations, monitoring enemy objects and overcoming various obstacles. However, traditional wheeled, tracked and even walking mobile robots have limitations in moving along vertical and complex terrain, as well as in quickly crossing water and obstacle barriers. The proposed research is aimed at creating a hybrid mobile robot that combines the capabilities of walking platforms and unmanned aerial vehicles (quadrocopters). Such hybridization will significantly expand the functional capabilities of the robotic system, increase the efficiency of reconnaissance tasks and reduce energy costs. Research objective Development of a mobile robot of arbitrary orientation in space with extended functional capabilities, capable of effectively performing reconnaissance tasks and overcoming obstacles in military conditions. The main development criteria are minimal energy consumption (electrical energy) when performing movements and maximum adaptability to different types of surfaces and environments.

2. RESULTS AND DISCUSSION

The effect of hybridization is a significant expansion of the functional capabilities of a mobile robot, namely, in addition to moving along horizontal, vertical and inclined surfaces, taking off to a given height, crossing various obstacles (walls, fences, ditches, trenches, rivers, etc.). Below are diagrams of one of the variants of the hybridization idea. Accepted designations in the diagrams:

П – walking mobile robot platform;

К – квадрокоптер (дрон);

Ш – a rod connecting the walking mobile robot and the quadcopter (it may not be present);

Alpha – the angle of inclination of the quadcopter axis relative to the platform; Plus (+) - movement is present; Minus (-) – movement is absent. Technical task – reconnaissance of enemy objects using artificial vision with a micro-camera on the drone and platform and demining using a laser device on the platform. Performing functions – movement on horizontal, vertical and inclined surfaces, take-off to a given height, crossing various obstacles (walls, fences, fences, ditches, trenches, rivers, etc.).

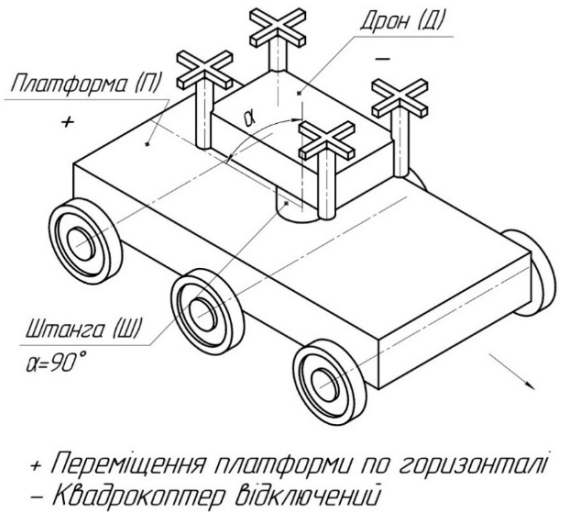

Fig. 1. Horizontal platform movement

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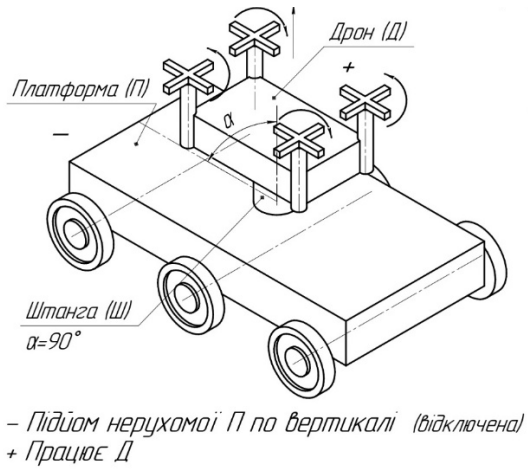

Fig. 2. Vertical lifting of a fixed platform

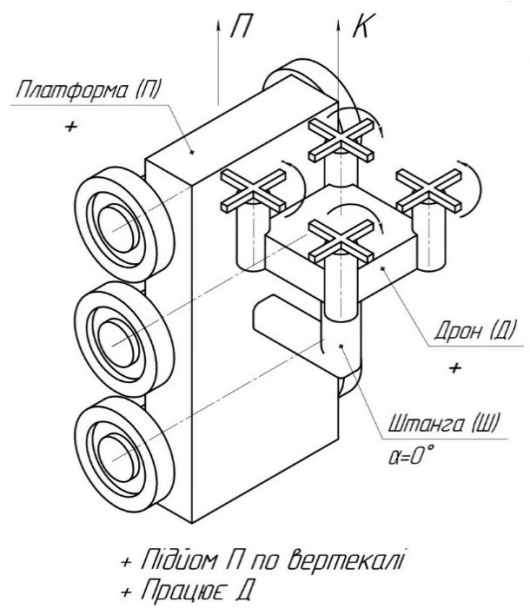

Fig. 3. Vertical movement of the platform

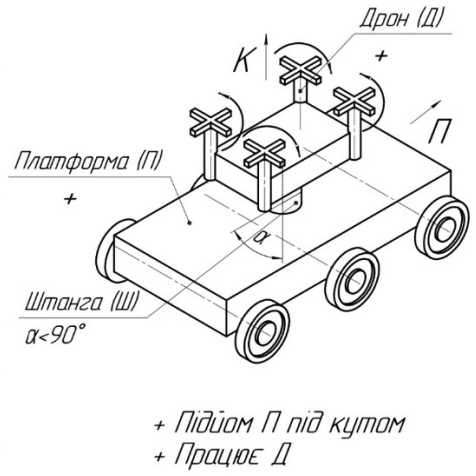

Fig. 4. Moving the platform at an angle

Problem statement and its connection with scientific and practical works The development of robotic systems requires the creation of universal platforms capable of moving effectively in different environments. Modern ground robots demonstrate high cross-country ability, but are limited in speed and ability to overcome vertical obstacles. Quadcopters, in turn, are mobile in the air, but have limited autonomy due to high energy consumption. The combination of these two approaches in a hybrid mobile robot will allow to obtain a system with increased adaptability and autonomy**.**

3. PURPOSE AND PROBLEM STATEMENT

The purpose of this article is to develop a concept for a hybrid mobile robot that combines the advantages of a walking platform and a quadcopter. The main tasks of the study include: 1. Analysis of technical requirements for a hybrid robot. 2. Development of a structural model taking into account the balancing of weight and strength. 3. Optimization of the control system for a smooth transition between movement modes. 4. Assessment of the energy efficiency of different operating modes. Presentation of the main material of the study The proposed concept involves the use of a lightweight but durable structure that combines mechanical limbs for movement on an uneven surface and propellers for flight. The main elements are: A frame made of lightweight composite materials. • An intelligent control system that uses machine learning to select the optimal mode of movement. • A modular battery system with energy distribution between flight and ground movement. • An adaptive stabilization system when transitioning between modes. Conclusions and prospects for further research The results of the study show that a hybrid mobile robot with the ability to walk and fly has significant potential in rescue operations, exploration of complex territories and the military sphere.

4. CONCLUSION

Further research will focus on improving control algorithms, reducing the weight of the structure and increasing the autonomy of work. As a recommendation, we can suggest the use of a multicopter (6 propellers) with a monowing and with a 90-degree rotation of the propellers after the transition from vertical lift to horizontal movement, i.e. use not a quadcopter (helicopter or helicopter), but a well-known rotorcraft. The monowing has a much greater lifting force.

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