EXPLORING THE POSSIBILITIES OF USING A DEVELOPED REMOTELY CONTROLLED MOBILE ROBOT

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Annotation
This article examines the construction of a remotely controlled mobile robot created 5 years ago at Alytus College, the possibilities of its use and the study of the possibilities of its use. During the study, the created mobile robot with other robots developed by foreign scientists is analyzed and compared and a corresponding way to use it is sought.
Key words: *robot, construction, control, research.*

Introduction

Lithuania is not known as the country of robot manufacturing, but even despite this, the modern business and social environment allows the production of specific robots, such as competition-having robotics, specialized industrial robotic solutions, agrotechnology with robot-specific properties, etc. The largest manufacturer of robots in the European Union we can call it Germany. This shows that its production in Europe is the best, characterized by quality and certainty. A robot is a mechanical machine capable of performing programmed physical tasks. Such a robot is able to imitate certain human qualities and perform work that requires extreme attentiveness. Such robots are designed in order to be able to change a person in the workplace in the future as moving pallets from place to place, etc. Today we see that the robot market is expanding significantly in various areas: in the machine-building, metalworking, transport, space and war industries. Lithuania according to the countries of the European Union is not among the manufacturers of robots. Some of the most used in the production of robotic machines in Europe and the world is the metal welding robot of the ABB firm. (2019). This company's metal welding robot can weld metal products of various sizes in the MIG/MAG way without human help. In other areas such as transport, autonomous robots are used that can deliver food to the door of houses, transport things within a certain set radius. One such robot is Starship. This robot moves at a pedestrian speed, safely surfs around objects and people. This robot has been developed by Korean scientists (Starship Technologies. 2016). The robots used in the space and military industries are similar to each other. In space, with robots, they study rocks, search for water and take all sorts of samples from the ground. Their construct is most often wheeled. Robots used in the military industry are usually provided for the life, demining and complex searches of a soldier. The construct of such robots is tracked, wheeled or stepping.

After paying attention to the constructions studied by other scientists, the possibilities of their use, we decided to examine the construct of the remotely controlled mobile robot created 5 years ago at Alytus College, the possibilities of its use and to conduct a study of the possibilities.

The aim of the study - to find out what the remotely controlled mobile robot construction created by Alytus College is made of and what are to him the possibilities of its use.

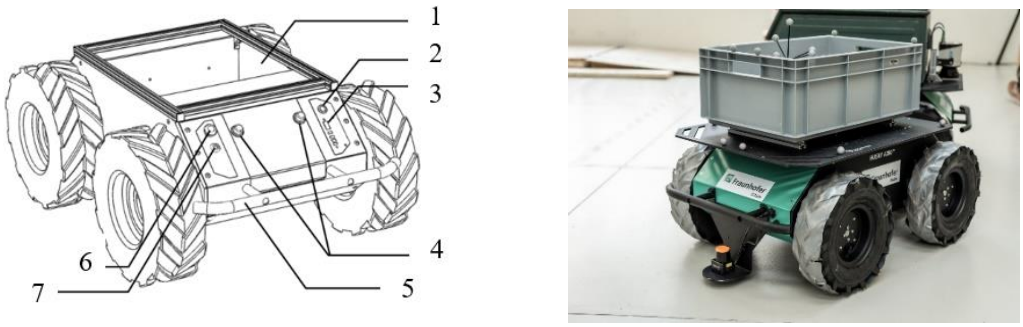
The task of the study are:

1. To carry out an analysis of the structures of remotely controlled mobile robots and the possibilities of their use.
2. To study the construct of a remotely controlled mobile robot created by Alytus College and describe its advantages and disadvantages.
3. To carry out a study of the possibilities of using the construct of a remotely controlled mobile robot developed by Alytus College.

Research methodology: review of scientific literature, analytical analysis, research, construct.

1. Analysis of remotely controlled mobile robot contruction and their usability

Remotely controlled mobile robot construction are made of various types: with a wheeled chassis, tracked chassis, stepping, etc. The constructions of manufactured mobile robots are simple, complex and expensive. One of the structures made by remotely controlled mobile robots is the HUSKY A 200. It is shown in Figure 1.



a) **b)**

Figure 1. Husky A200 robot: a – robot construction: 1 – platform, 2 – power button, 3 – energy vision panel, 4 – batteries and access buttons, 5 – rear bumper tape, 6 – emergency stop button, 7 – lock; b – General construction of the robot (Husky user manual, unmanned ground vehicle, 2014)

This mobile construction of the robot is designed to be used for independent tasks in logistics and construction sites. The robot weighs 50 kg, has a maximum load of 75 kg, a max. speed of 1 m/s, a battery of 24V 20Ah, can enter a 45-degree hill. (Electric motor engineering, 2023). This mobile robotic robot is equipped with a platform, an on and off button, an energy vision panel, batteries and an access button, an emergency turner, a lock button, as well as an electronic control and acceleration unit, laser and displacement sensors that helps you drive on uneven terrain. The information that the robot receives using BIM data can help improve its navigation capabilities and sensory perception. The main advantage is that BIM data allows a mobile robot to transport heavy loads, such as building materials and tools in an ever-changing environment, in order to reduce the workload of people on the construction site. Such a mobile robot has been developed by a group of scientists from the Fraunhofer Italia Innovation Engineering Center.

A group of NASA scientists in 2012 has developed a 6-wheeled Martian robot named Curiosity. It is designed to study rocks and whether the planet is suitable for living. The design of the Curiosity robot is shown in Figure 2.

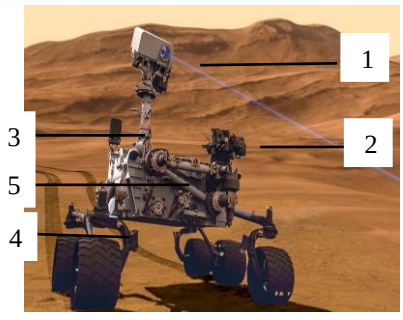


Figure 2. ,,Curiosity" robot design: 1 – laser, 2 – satellite dish, 3 – video camera, 4 – wheels, 5 – software

Curiosity's robotic construct includes a laser, a satellite dish, a video camera, wheels, and software. The installed laser in the robot can hit unknown objects and random targets and transmit to scientists the particles obtained for analysis. The camera transmits the general view of the terrain, the satellite antenna transmits the signal to the ground via a connection. A robot with 6 wheels can stably climb a steep mountain, feel safe in an unknown environment. In order to improve research on Mars, scientists decided to install a new piece of software on this robot called Autonomous Exploration for Gathering Increased Science (AEGIS) (Curiosity rover

himself decides what to study on Mars, 2017). After installing this software, scientists say that the robot will be able to scan every new location of an object or target faster and use artificial intelligence.

Others use remotely controlled mobile robots with a tracked chassis. With a tracked chassis, mobile robots are used to perform difficult, dangerous tasks. One such robot is named "TEODOR", which is shown in Figure 3.

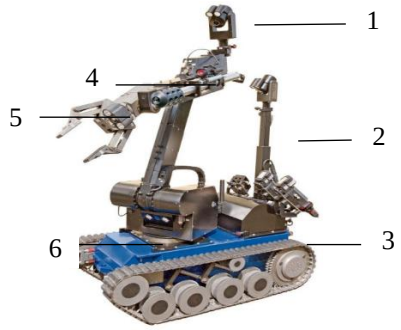


Figure 3. Mobile robot "TEODOR": 1 – 3D video camera, 2 – radio communication antenna, 3 – tracks, 4 – telescope, 5 – manipulator's hand, 6 – battery (2014)

A mobile all-terrain robot with the caterpillars is controlled wirelessly through the radio pad. In order to control it through the radio pad, an antenna is installed. The ,,Teodor" robot has a lead gel battery. The battery gives the robot power and is completely independent. He also has a manipulator. The manipulator can safely lift the load up to 30 kg and rotate at an angle of 360°. The telescopic module allows you to lengthen the manipulator arm to 400 mm. Also, this robot is equipped with detection sensors and a 3D camera that allows you to assess the passage ability of the terrain in order to navigate safely (DE CUBBER G, BALTA H, LIETART C, 2014). Stepping robots are used in places of lost, inaccessible gorges, in deep caves to search for people and monitor dangerous places. The construct of the stepping robot, the JinPoong, is shown in Figure 4.

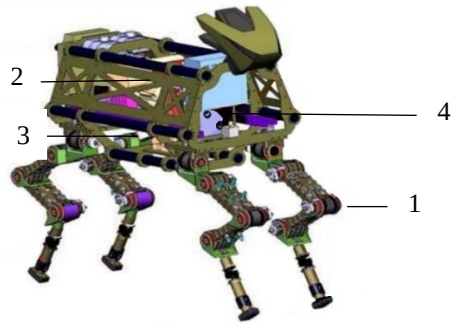
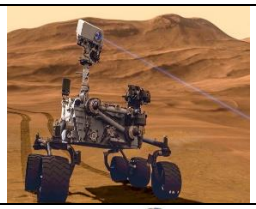


Figure 4. ,,JinPoong" stepping robot: 1 – legs, 2 – battery, 3 – motor, 4 – hydraulic drive (2013)

This step-by-step four-legged robot, ,,JinPoong", is developed by scientists from the Korean Institute of Industrial Technology (Kitech). This stepping four-legged robot consists of four legs, a battery, a motor, a hydraulic drive. The hydraulic drive allows the robot to move quickly in uneven places. The size of this robot is l.2 m x 1 m x 1 m x 1 m (height, length and width, respectively). (2013). The degree of freedom of movement is fifteen. It can withstand a total weight of more than 100 kg including 60 kg of the payload available. The common control system consists of the main control system, the hydraulic servo system and the engine / power control system. Table 1 shows the technical parameters and possibilities of use mobile robots.

Table 1

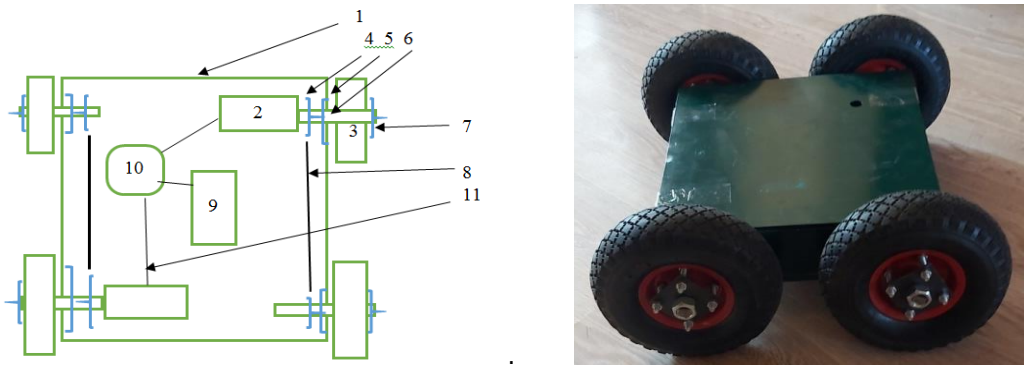
Mobile robots technical parameters and possibilities use table

Nr.	Robots	Technincal parameters	Possibilities	Construct
1.	,,HUSKY A200”	Dimension: 990 mm x 670 mm x 390 mm Speed: 1 m/s Max.load: 75 kg Uphill angle: 45°. Operating time: 3-8 h Weight: 50 kg.	For independent tasks of logistics and cons-truction squares.	
2.	,,Curiosity”	-	Exploring rocks and the planets.	
3.	,,TEODOR”	Dimensions:1100x680x300 Battery charging: 2-3 h Uphill angle: 45°. Speed: 3 km/h Weight: 350 kg	For heavy, dangerous tasks.	
4.	,,JinPoong”	Dimensions: l.2 x 1 x 1 m Speed: 1.5 m/s Weight: 100 kg	In places of lost, inaccessible gorges, in deep caves for the search for people and for observing dange-rous places.	

According to the information in Table 1, it can be said that mobile robots can be used in complex areas to solve simple, complex, dangerous tasks. The possibilities of using the robot can be limited, which depends on the complexity of the task and other environmental factors.

2. The design of a remotely controlled mobile robot created by Alytus College, its advantages and disadvantages

The design of the remotely controlled mobile robot is made in 2018 at Alytus College. The mobile design of the robot is shown in Figure 5



a) **b)**

Figure 5. Alytus College remotely controlled mobile robot construct: a – construct (1. Robot body; 2. Engine; 3. wheel; 4. Asterisk; 5. Bearing; 6. Axis; 7. The adapter is designed to connect the wheel with the axis; 8. Chain; 9. Battery; 10. Control unit; 11. Cord).; b – construction (2020)

This shown mobile construct of the robot is made up of such structural details: the housing; engine; wheel; stars; bearing; axis; adapter; chain; battery; control unit; wiring. It weighs 30 kg, dimensions: 400x400 mm, has a GPS satellite system. The system installed by the GPS satellite broadcasts the exact time of the transmitted signal The principle of operation of this mobile robot construct is as follows: The control unit (10) through the wires (11) directs

the electricity contained in the battery (9) to the engines (2). Under the influence of electricity, they begin to rotate and transmit torque through the axis (6) which is fixed in the bearing (5), and the adapter (7) to the wheel located near the engine. Another wheel on the same side receives torque when the first axle rotates the asterisk on it (4), and it transmits torque through the circuit (8) to the next star, which rotates the second axis. The second axle, which is connected by the adapter to the second wheel of the same side, thus transmitting torque to the second wheel of the same side. In this way, all four wheels of the robot are driven, thereby increasing the possability of the robot's chassis. (Vabolys M, Šaulys P, Niauronis S, Stonys, G. 2020).

The pros and cons of this mobile robot are presented in Table 2.

Table 2

Mobile robots pros and cons

Pros	Cons
• The mobile robot is small in size; • There is no complicated construction; • Has a GPS satellite system; • Controlled by a smart device, an Android phone; • Can overcome hills up to 10º; • Can develop max. speeds up to 3 km/h; • May pass obstacles on the road; • Can drive on surfaces of most types of soils.	• The mobile robot is not adapted for long distances; • The capacity of the battery could be larger; • Does not have a connection with the terrain of the antenna and camera; • Does not have special equipment to pick up cargo or dangerous substances, etc.

3. Study of the possibilities of using the design of a remotely controlled mobile robot developed by Alytus of College

The possibilities of using the created remotely controlled mobile robot are not great for the time being, because its resources are too small to do something. Comparing with the other mobile robots listed in section 1, we note that the construct of this robot is simple, simple, with a small weight and small size. Also, the mobile construct of the robot can be currently used to transport small-sized cargoes and deliver them to the specified location according to the signal specified by the GPS satellite. In order to safely deliver the cargo before transportation will have to be stably fixed on the platform, and only after that transported. The weight of the cargo should be approximately from 5 to 20 kg. To find out at what speed a mobile robot could transport cargo on different surfaces of the soil, a study was conducted for this. This study was conducted on September 30, 2020. Alytus College (Vabolys, M. Šaulys, P. Niauronis, S. Stonys, G., 2020). The results of the conducted study can be seen in Fig. 6.

Figure 6. Mobile robots speed on paved, gravelled and lawn paved (2020)

The presented results of the study show that a mobile robot can develop speeds of up to 3 km / h on paved, gravelly and lawn surfaces by 2 km / h. The robot could run faster and longer, but it may not have enough power from existing motors and battery resources.

Also, a mobile robot could be used to pick up or mine hazardous chemicals, since high speeds are not required here. To solve such tasks, it would be necessary to attach a video camera, a manipulator to the platform of a mobile robot with which to take the chemicals or the mine. The manipulator could be small, of uncomplicated design and spin at an angle of 360º.

Conclusions

1. After analyzing the construct and usability of remotely controlled mobile robots, we note that the design and management are complex, and the possibilities of their use are high. Some mobile robots can be used for food distribution, others for welding, monitoring dangerous areas, exploring the ground and rocks, and demining.

2. Having studied the construct of the remotely controlled mobile robot created by Alytus College, its advantages and disadvantages, it can be said that the design and operation of this robot is uncomplicated, but the possibilities of use are not great, do not have some installed tools for the performance of complex tasks.

3. Conducted on 30.09.2020. The study of the possibilities of using the construct of a remotely controlled mobile robot developed by Alytus College shows that the robot can travel on a paved surface at a speed of up to 3 km / h, gravelly and lawn surface at a speed of 2 km / h. According to this, we can also judge that the robot could in principle be used to transport small loads, perform simple tasks and apply mine search special means to search mines to ensure the life of a soldier, since its speed is small up to 3 km / h, the passage is good, the road is stable.

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Received: 26 May 2023
Accepted: 1 Juny 2023